STATE OF CALIFORNIA
The Resources Agency

Department of Water Resources

BULLETIN No. 74-9

Water Well Standards

VENTURA COUNTY

AUGUST 1968

RONALD REAGAN
Governor
State of California

WILLIAM R. GIANELLI
Director
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FOREWORD

Bulletin No. 74-9 contains the results of a study conducted by the Department of Water Resources to develop standards for the construction and destruction of water wells in Ventura County. It is one of a series of reports dealing with the problem of preventing deterioration of ground water quality as facilitated by poorly constructed or improperly destroyed water wells.

The report recommends that water well standards be established in Ventura County. The specific standards presented are based on the subsurface geology, hydrology, and water quality conditions of the ground water basins of Ventura County, and are designed to be used in conjunction with Bulletin No. 74, "Water Well Standards: State of California".

William R. Gianelli

William R. Gianelli, Director
Department of Water Resources
The Resources Agency
State of California
June 19, 1968

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State of California
The Resources Agency
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CALIFORNIA WATER COMMISSION

AUTHORIZATION

The Water Well Standards Program under which this report was prepared is authorized by Section 231 of the Water Code, State of California which reads:

> "231. The department, either independently or in cooperation with any person or any county, state, federal or other agency, shall investigate and survey conditions of damage to quality of underground waters, which conditions are or may be caused by improperly constructed, abandoned or defective wells through the interconnection of strata or the introduction of surface waters into underground waters. The department shall report to the appropriate regional water quality control board its recommendations for minimum standards of well construction in any particular locality in which it deems regulation necessary to protection of quality of underground water, and shall report to the Legislature from time to time, its recommendations for proper sealing of abandoned wells."

In 1967 the Legislature established a procedure for implementing standards developed under Section 231 by enacting Chapter 323, Statutes of 1967, which added Sections 13800 through 13806 to the Water Code. In Section 13800, the Department of Water Resources' reporting responsibility is enlarged upon:

> "13800. The department, after such studies and investigations pursuant to Section 231 as it finds necessary, on determining that water well construction, maintenance, abandonment, and destruction standards are needed in an area to protect the quality of water used or which may be used for any beneficial use, shall so report to the appropriate regional water quality control board and to the State Department of Public Health. The report shall contain such recommended standards for water well construction, maintenance, abandonment, and destruction as, in the department's opinion, are necessary to protect the quality of any affected water."

ACKNOWLEDGMENTS

Valuable assistance and data used in this investigation were contributed by agencies of the Federal Government, the State of California, cities, counties, public districts, private companies, and individuals. This cooperation is gratefully acknowledged. We are particularly grateful for the cooperation of the following:

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Department of Water of City of Oxnard

City of Port Hueneme

Continental Oil Company

Farmers Irrigation Company

Leonard A. Anderson Water Well Drilling Company

Midway Drilling and Pump Company

Shell Oil Company

United Water Conservation District

Water Resources Division of Ventura County
Department of Public Works

ABSTRACT

The study disclosed that, in most cases, the ground water basins of Ventura County contain waters of good quality. However, in several of the basins, the water from certain wells has been of lower quality than that from surrounding wells. In most cases, the character of the degraded water is more like that of nearby sewage discharge, drainage channel water, oil field waste, or sea water. / Three different areas -- with specific differences in degree of need for water well standards -- can be established for Ventura County on the basis of the quality of the water. / It is recommended that local agencies adopt the standards as set forth in this bulletin.

CHAPTER I. INTRODUCTION AND SUMMARY

The quality of the ground water within the basins of Ventura County has deteriorated measurably over the past few decades. This deterioration has generally coincided with increased water use. However, in localized areas, studies have shown that sewage, industrial wastes, irrigation return water, and other water of poor quality have migrated downward into the water-bearing zones and have impaired the quality of the ground water for some beneficial uses.[1/] In addition, overpumping of aquifers in contact with the ocean has been found to cause the reversal of ground water gradients, resulting in the intrusion of sea water, which also has migrated into lower aquifers.

One of the principal routes by which this migration can take place has been found to be the network of water wells, many of which have been improperly constructed or destroyed.

In Ventura County, where the major source of water is the ground water basins, preservation of the usefulness and maintenance of good quality water within these natural storage facilities is vitally important to the growth of the County.

[1/] See Appendix B for definition of terms used in this report.

Objective and Scope of Investigation

The objective of this investigation was to formulate standards for the construction and destruction of water wells in Ventura County that will serve as a basis for legislation by local governing agencies.

To be able to determine standards for water wells within the basins of Ventura County, it was necessary to study and interpret all available geologic, hydrologic, and water quality data in the files of the Department of Water Resources and those collected from other agencies and individuals.[2/] Considerable effort was expended in parts of the County where basic data were lacking to locate wells and to collect surface and ground water samples.

These data were used to interpret surface and subsurface geologic conditions; to evaluate ground water elevations and direction of ground water movement; to locate sources of ground water replenishment; to determine ground and surface water quality characteristics; and to determine areas of water quality impairment for the purpose of delineating areas requiring specific standards for construction and sealing.

To present a current picture of the water quality conditions, mineral analyses for the period 1960-64 were used. However, in areas where water quality data were lacking, additional water samples were collected for mineral analyses during the latter part of 1964 through 1965. In areas where additional data could not be obtained, mineral analyses prior to 1960 were utilized.

[2/] See Appendix A for a list of references used in this study.

All supporting data used in this investigation are catalogued and maintained in the basic data files of the Department.

Area of Investigation

The area of investigation comprises all Ventura County, with the exception of Anacapa and San Nicolas Islands. Ventura County forms a part of the south coastal area of Southern California and is bounded on the west by Santa Barbara County, on the north by Kern County, on the east and southeast by Los Angeles County, and on the southwest by the Pacific Ocean. The boundaries encompass an area of approximately 1,850 square miles. This area is shown on Plate 1.

The County is characterized by rugged mountainous terrain in the northern portion and lower mountains and alluvial valleys in the central and southern portions. Elevations range from sea level along the coastal margins to 8,831 feet at Mount Pinos near the northern boundary of the County.

The Mediterranean-type climate typical of the south coastal area prevails in Ventura County, with proximity to the ocean providing a moderating effect on the climate throughout the area. A long, dry, warm summer season is followed by a shorter, wet winter period accompanied by cooler temperatures. More than 80 percent of the mean seasonal precipitation occurs from December through March. Precipitation is generally in the form of rainfall, except in the mountainous regions, where there is some snowfall. The mean seasonal precipitation varies from about 32 inches in the Topatopa Mountains to about 12 inches in the vicinity of Point Mugu.

Urban and suburban expansion together with light industry growth are completely changing the pattern of land use. Some of the land use data summarized in DWR Bulletin No. 122, "Ventura County and Upper Santa Clara River Drainage Area Land and Water Use Survey, 1961", are given below:

> "3. The gross urban and suburban acreage expanded from 29,300 acres in 1950 to 52,000 acres in 1961, an increase of 22,700 acres, or more than 77 percent.
>
> "4. The gross irrigated agriculture acreage decreased slightly from 123,100 acres in 1950 to 122,600 acres in 1961, a reduction of 500 acres."

The population growth reflected by the increasing urban and suburban acreage is borne out by the federal census. The 1960 census reported the population of Ventura County to be 199,138 as compared to the 1950 population of 114,657. This was an increase of about 74 percent.

The Calleguas Municipal Water District, a member of The Metropolitan Water District of Southern California (MWD), currently imports water. The amount of water furnished by MWD will increase from approximately 12,000 acre-feet, fiscal year 1964-65, to 254,000 acre-feet by fiscal year 2019-20. The Calleguas Municipal Water District covers an area of about 175,000 acres. Its irregular boundaries extend from the east county line to just beyond Camarillo on the west; the northern boundary lies south of the Santa Clara River Valley; and its southern boundary lies south of Thousand Oaks and the California State Hospital.

In 1980, the Ventura County Flood Control District will begin receiving State Water Project water, starting with 1,000 acre-feet a year and increasing steadily until a maximum of 20,000 acre-feet a year is reached in 1990. The Ventura County Flood Control District will make this water available to other water districts in the county

The major portion of Ventura County lies within the boundaries of the Los Angeles Regional Water Quality Control Board (No. 4). The remaining portions lie within the boundaries of the Central Coastal Regional Water Quality Control Board (No. 3) and the Central Valley Regional Water Quality Control Board (No. 5).

Summary of Findings

During this investigation, the findings listed below were determined.

1. With few exceptions, the ground water basins of Ventura County contain waters of good quality.

2. Generally, the quality of the ground waters of the basins improves with depth.

3. There is a discernible difference in quality of water between basins and between aquifers within basins. On the basis of these differences, the area may be divided into three zones, the boundaries of which are shown in Figure 4 in Chapter IV.

4. In the Oxnard Basin (Pressure Area), water of extremely poor quality is found in the uppermost water-bearing sediments.

5. Along the coastal margin of the basins, the lower Pleistocene deposits underlying the mouth of the Ventura River and the Oxnard and Mugu aquifers have been intruded by sea water.

6. The mineral quality of sewage and industrial waste waters in Ventura County is generally inferior to the quality of water yielded by the deeper aquifers.

7. In several of the basins are found wells that yield water of lower quality than that from the wells around them. In most cases,

character of the degraded water is more like that of nearby sewage discharge, drainage channel water, oil field waste, or sea water.

Conclusions

On the basis of these findings, it is concluded that:

1. Improperly constructed, destroyed or defective wells may cause poor quality water from one aquifer to invade another containing good quality water.

2. In most of Ventura County (identified as Zone I) the general standards presented in Chapter II of Department of Water Resources, Bulletin No. 74, "Water Well Standards: State of California", are sufficient to protect the quality of the existing ground water supplies. However, in Zone II specific standards are necessary to prevent the percolation of poor quality surface or shallow ground water; and in Zone III, specific standards are necessary to protect the aquifers underlying the sea-water-intruded Oxnard and Mugu aquifers from the percolation of impaired waters.

3. The boundaries of the zones established may require revision as additional data become available, especially for the northern basins of the County.

4. Compliance with the water well construction standards set forth in this report will reduce impairment of ground water quality that results from improperly constructed or destroyed wells.

Recommendations

1. In accordance with the provisions of Section 13800 of the Water Code, it is recommended to the Central Coastal, Los Angeles, and Central Valley Regional Water Quality Control Boards and to the California Department of Public Health that water well standards be established in Ventura County.

2. It is further recommended that the general standards presented in Chapter II of the Department of Water Resources Bulletin No. 74, "Water Well Standards: State of California", February 1968, together with the specific standards presented in this report on Pages 41 through 47, form the basis for those to be established in Ventura County.

CHAPTER II. OCCURRENCE AND MOVEMENT OF GROUND WATER

The nature and extent of the ground water basins in Ventura County and the distribution and sequence of the water-bearing materials contained in them were determined from geologic studies of the area. Hydrologic studies were used to determine the replenishment of ground water supplies and the manner and amount of discharge of ground water.

The information presented is based on data contained in Bulletin No. 12, "Ventura County Investigation", published by the California Water Resources Board. The bulletin contains a comprehensive discussion on the geology and hydrology of Ventura County.

Occurrence of Ground Water

Deposition of the water-bearing sediments in Ventura County, as well as the development of the ground water basins that contain them, is the result, for the most part, of geologic events since Pliocene time. The areal distribution and description of the geologic units are on Plate 1.

The ground water basins of Ventura County are the water-bearing portions of the hydrologic units that are shown on Plates 2A, 2B, and 2C. These ground water basins are also listed in Table 1.

Water-bearing materials in the study area consist of layers of gravel and sand, usually separated by layers of silt and clay. Between the particles in the gravel and sand layers are relatively large spaces where water can be stored and through which it can be transmitted.

These coarse-grained deposits, which yield water to wells in usable amounts, are called aquifers. The aquifers that have been delineated within the study area are shown on Plates 3A and 3B and in Table 1.

GROUND WATER BASINS IN VENTURA COUNTY

Ground water basins	Water-bearing formations	Principal aquifers	Condition of occurrence of ground water
Upper Ojai	Recent and Pleistocene alluvium	Lenses of permeable sediments	Unconfined
Ojai	Recent and Pleistocene alluvium	Lenses of permeable sediments	Essentially unconfined, locally semiconfined
Upper Ventura River	Recent and Pleistocene alluvium	Sand and gravel beds	Unconfined
Lower Ventura River	Recent and Pleistocene alluvium	Sand and gravel beds	Unconfined
Piru	Recent and Pleistocene alluvium	Sand and gravel beds	Unconfined
	San Pedro formation	Sand and gravel beds	Unconfined
Fillmore	Recent and Pleistocene alluvium	Sand and gravel beds	Unconfined
	San Pedro formation	Sand and gravel beds	Unconfined
Santa Paula	Recent and Pleistocene alluvium	Lenses of permeable sediments	Essentially unconfined
	San Pedro formation	Lenses of permeable sediments	Essentially unconfined
Mound	San Pedro formation	Lenses of permeable sediments near top	Confined
Oxnard Forebay Area	Recent and Pleistocene alluvium	Most of the formations	Unconfined
Oxnard Pressure Area	Recent alluvium	Semiperched water-bearing zone	Unconfined
		Oxnard aquifer	Confined
	Upper Pleistocene alluvium	Mugu aquifer	Confined
	San Pedro Formation	Hueneme aquifer Fox Canyon aquifer	Confined
Pleasant Valley	Recent and Pleistocene alluvium	Permeable lenses not connected with Oxnard aquifer	Essentially confined
	San Pedro Formation	Fox Canyon aquifer	Essentially confined
Simi	Recent and Pleistocene alluvium	Lenses of permeable sediments	Mostly unconfined, some confined in western part of basin
	Older formations	Fracture zones and permeable lenses	Essentially unconfined
East and West Las Posas	Recent and Pleistocene alluvium	Lenses of permeable sediments	Unconfined
	San Pedro Formation	Epworth gravels	Essentially confined
		Fox Canyon aquifer	Confined except near outcrop

GROUND WATER BASINS IN VENTURA COUNTY
(Continued)

Ground water basins	Water-bearing formations	Principal aquifers	Condition of occurrence of ground water
East and West Las Posas (cont'd)	Santa Barbara Formation	Grimes Canyon aquifer	Confined except near outcrop
Conejo	Recent and Pleistocene alluvium	Lenses of permeable sediments	Unconfined
	Volcanics and older sedimentary rocks	Fracture zones and permeable lenses in sedimentary rocks	Essentially unconfined
Tierra Rejada	Volcanics	Fractures zones	Essentially unconfined
Arroyo Santa Rosa	Recent and Pleistocene alluvium	Lenses of permeable sediments	Unconfined
	San Pedro Formation	Fox Canyon	Confined
	Volcanics	Fractured zones	Confined and unconfined
Russell Valley	Alluvium and volcanic	Lenses of permeable sediments and fractured zones	Unconfined
Sherwood	Alluvium and volcanic	Lenses of permeable sediments and fractured zones	Unconfined
Stauffer	Quaternary and Tertiary rocks	Lenses of permeable sediments	Unconfined
Cuddy Valley	Quaternary and Tertiary rocks	Lenses of permeable sediments	Unconfined
Cuyama Valley	Quaternary and Tertiary rocks	Lenses of permeable sediments	Unconfined
Rincon Creek	Recent and Pleistocene alluvium	Lenses of permeable sediments	Unconfined
Hungry Valley	Quaternary and Tertiary rocks	Lenses of permeable sediments	Unconfined
Carpenteria	Recent and Pleistocene alluvium	Lenses of permeable sediments	Essentially unconfined
Gillibrand	Recent and Santa Barbara Formation	Lenses of permeable sediments	Essentially unconfined
Thousand Oaks	Quaternary and Tertiary rocks	Lenses of permeable sediments and fractured zones	Unconfined
Las Virgenes Canyon	Quaternary and Tertiary rocks	Lenses of permeable sediments and fractured zones	Unconfined
Lindero Canyon	Quaternary and Tertiary rocks	Lenses of permeable sediments and fractured zones	Unconfined
Big Sycamore Canyon	Quaternary and Tertiary rocks	Lenses of permeable sediments and fractured zones	Unconfined

Some of the aquifers have been assigned names. In the Oxnard Plain, for example, stream-deposited sand and gravel form an extensive aquifer that has been designated the Oxnard aquifer. Figure 1 shows the areal extent and lines of equal elevation on the base of the aquifer.

Below this aquifer lies a less important one from a water supply standpoint; this has been designated the Mugu aquifer. Figure 2 shows the lines of equal elevation on the base of the coastal portion of this aquifer.

Movement of Ground Water

Ground waters within Ventura County generally move in a westerly and southwesterly direction, except in localized regions where the flows are influenced by local geologic and hydrologic conditions.

Geologic structures in the study area that affect the occurrence and movement of ground water are faults and folds. Faults have disrupted the water-bearing strata enough to interrupt the flow of ground water, and folding of sedimentary rocks has exposed nonwater-bearing rocks that generally limit the movement of ground water and thus has resulted in the dewatering of potentially water-bearing materials. The effects of these structures on the aquifers of the study area are shown in the sections on Plates 3A and 3B.

Replenishment for the ground water basins comes from percolation of precipitation, surface runoff, artificial spreading, applied water, and discharged treated sewage, and from subsurface inflow. Colorado River water, although not imported for direct replenishment of the basins, eventually reaches the ground waters of the basin after use.

In areas where sands and gravels immediately underlie the surface of a ground water basin, deep percolation to the underlying water table of precipitation, surface water runoff, and spread water is unrestricted.

The fine-grained materials, particularly the clays, have only minute spaces between the particles and, therefore, offer resistance to the movement of water.

The layers between aquifers that do not furnish enough water to supply wells are called aquicludes. Generally, aquicludes reduce the rate of vertical movement of ground water, including movement downward from the ground surface and movement between aquifers. Thus, the location of aquicludes influences the determination of water well standards.

However, even where surface layers of low permeability exist, limited quantities of water do percolate to the underlying ground water table via lenses of clayey sands and gravels or lenses of sand and gravel or both.

Subsurface flow from the study area under natural conditions is to the Pacific Ocean and through the sediments underlying the Cuyama River across the county line within the Cuyama Valley Basin.

In recent years, increased extractions of ground water, combined with a reduction in the amount of ground water replenishment, have caused the water table to be lowered. Locally, along the coastal margins, normal ground water gradients have been reversed, permitting sea water to move inland. In other areas, troughs, or pumping depressions, have developed in the ground water surface.

The major discharge of ground water is by pumping, with extracted water being used for agricultural, industrial, and municipal purposes.

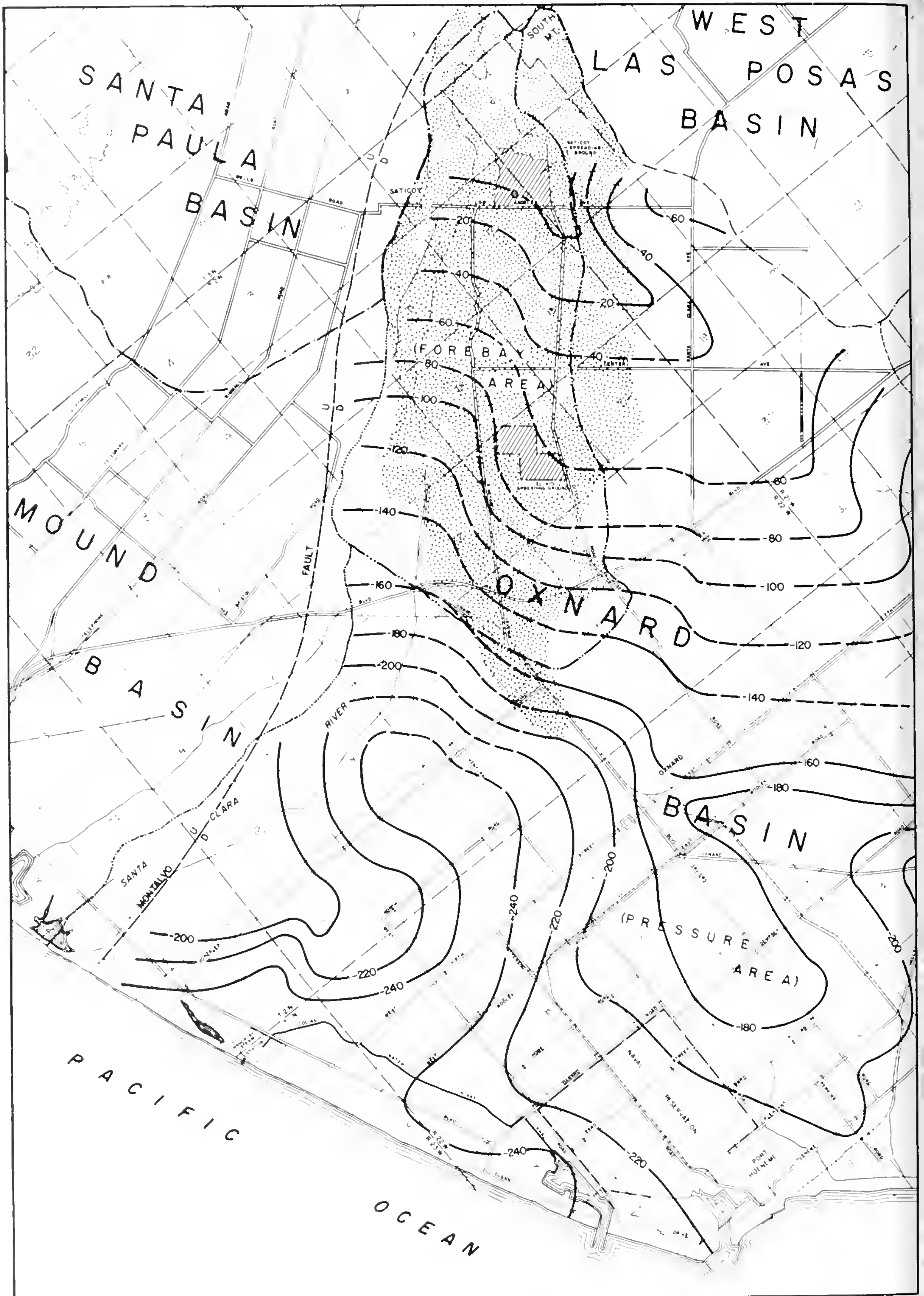
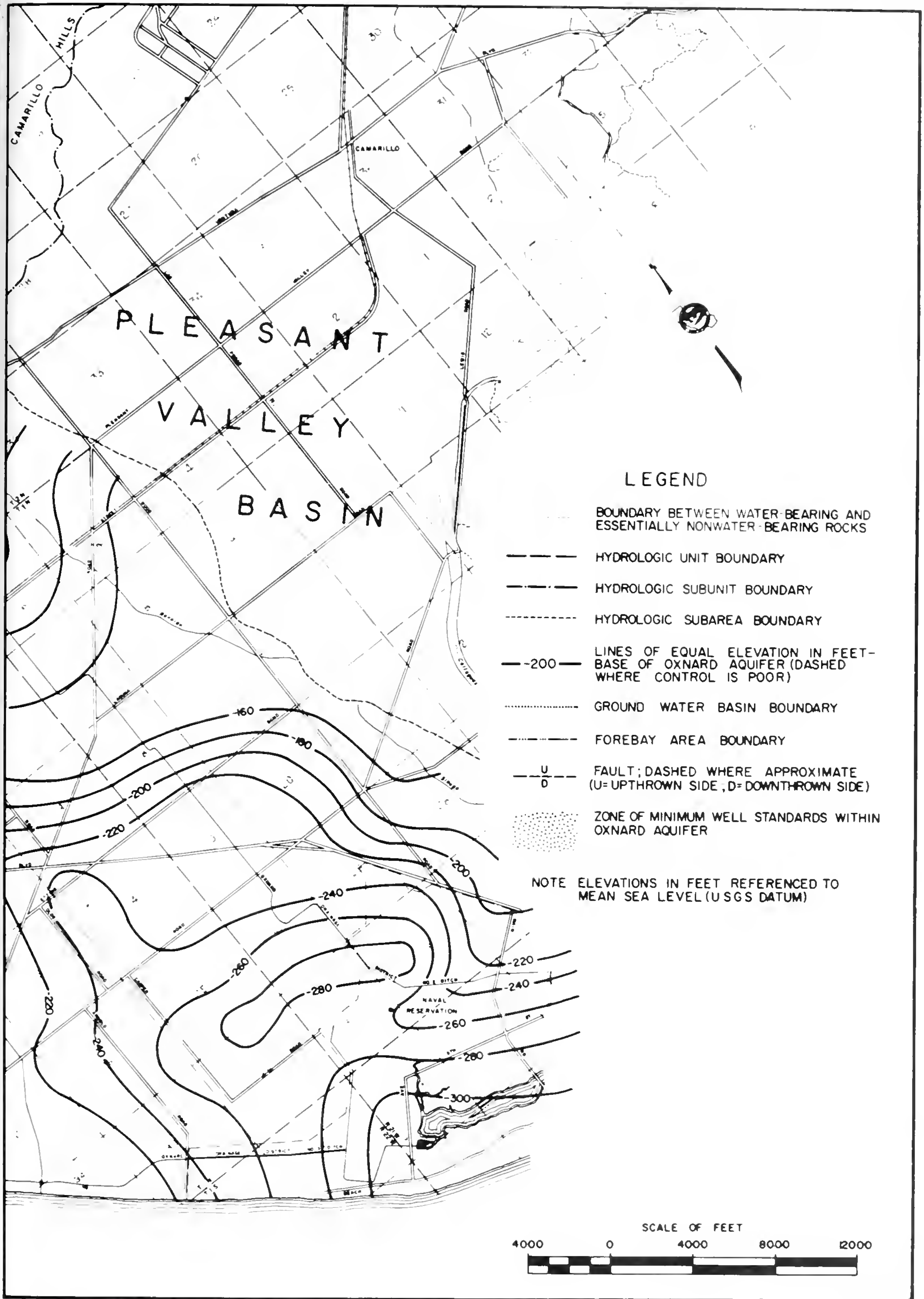


Figure I – LINES OF EQUAL ELEVA



TION — BASE OF OXNARD AQUIFER

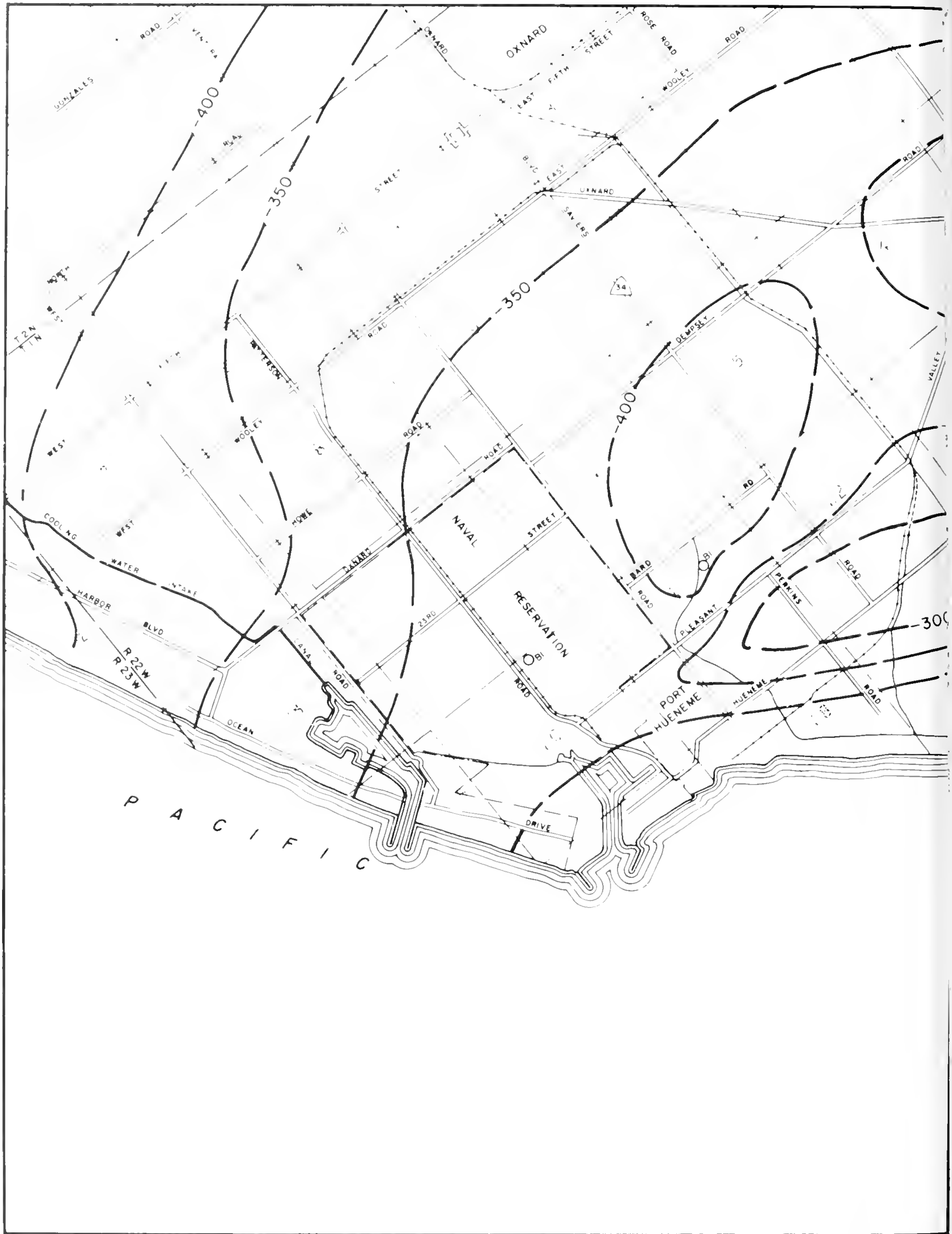
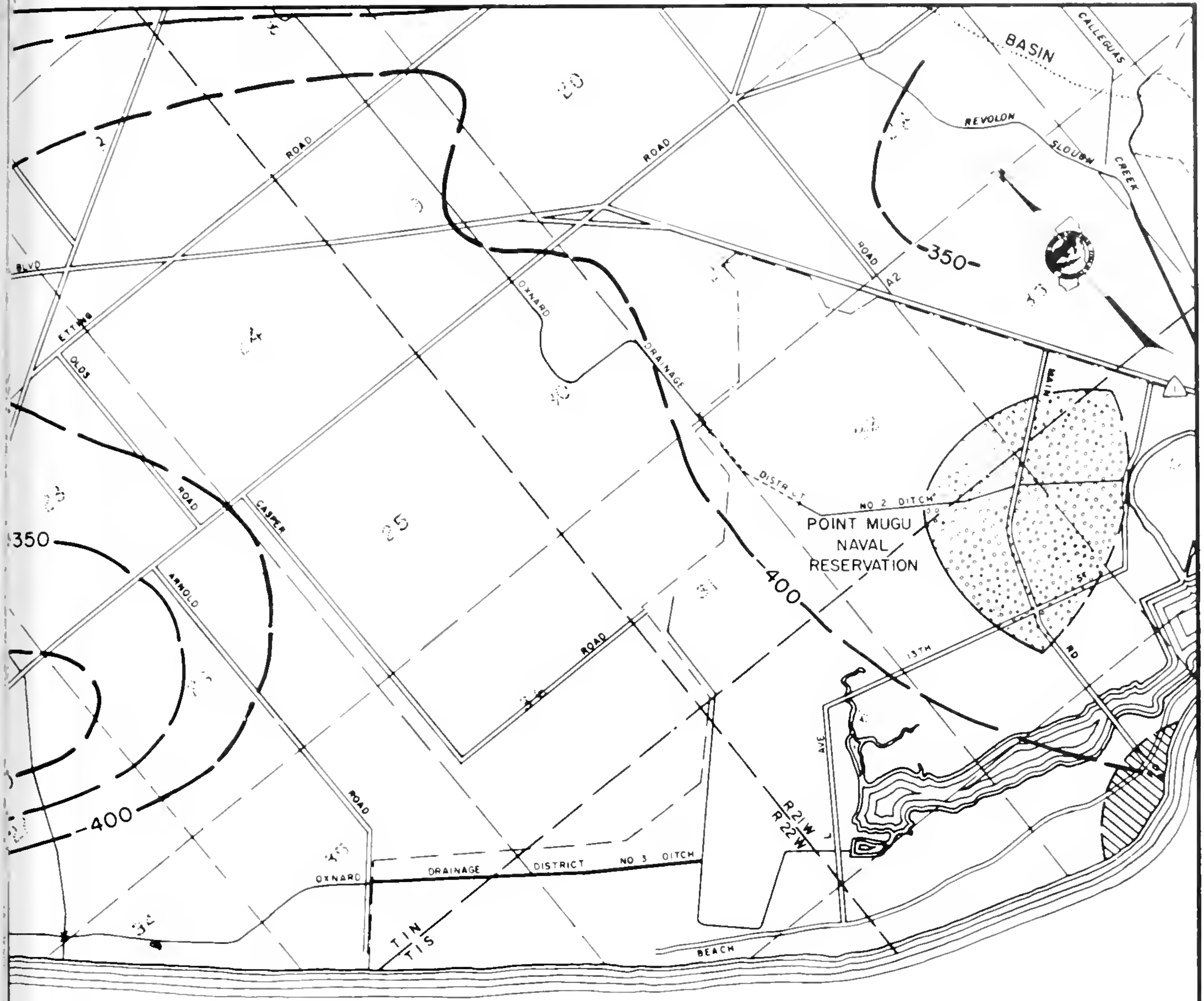


Figure 2 — LINES OF EQUAL ELEVATION

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT, 1968



L E G E N D

AREA WHERE THE MUGU AQUIFER IS IN PROBABLE HYDRAULIC CONTINUITY WITH THE OXNARD AQUIFER

AREA WHERE THE MUGU AQUIFER IS IN PROBABLE HYDRAULIC CONTINUITY WITH THE FOX CANYON AQUIFER

-100 LINES OF EQUAL ELEVATION ON THE BASE OF THE MUGU AQUIFER

B1 MUGU AQUIFER INTRUDED BY SEA WATER

NOTE CONTOURS ARE REFERENCED TO MEAN SEA LEVEL, U S G S DATUM

SCALE OF MILES

1 0 1

ON THE BASE OF THE MUGU AQUIFER

CHAPTER III. QUALITY OF WATER AND FACTORS INFLUENCING IT

The purpose in formulating water well construction and sealing standards for Ventura County is to help protect and preserve the quality of ground water. To establish standards that will be effective in achieving this, a knowledge of the ground water quality of the basins and an understanding of the factors affecting that quality are essential. Water quality criteria used in this chapter are presented in Appendix D.

Ground Water Quality

In general, much of the ground water is of suitable or marginal quality for prevailing beneficial uses. There is a discernible variation in both the character and quality, not only between basins but also between aquifers within basins. A comprehensive discussion of the ground water quality is given in DWR Bulletin No. 75, "Water Quality and Water Quality Problems, Ventura County", February 1959.

A study of the water quality data and the geologic conditions throughout the County shows that only in certain basins will the implementation of supplemental standards maintain or improve the quality of the ground water. Therefore, in the discussion that follows, only data from these basins are given.

Water well construction data and related mineral analyses made possible the correlating of the ground water samples with depth and, thus, the establishing of sealing zones based on the subsurface geology.

In addition, in the Oxnard Basin (Pressure Area), the water quality data were correlated with the named aquifers whenever this was

possible. Usually, the ground water quality is better at increasing depths in this basin as well as throughout the area.

Fillmore Basin

Ground water of this basin (see Table 2) varies in quality from Class 1 to Class 3 for irrigation use. However, the quality of the water extracted from wells in excess of a depth of 150 feet is Class 1 to Class 2 for irrigation use.

Certain constituents, notably sulfate, nitrate, and total dissolved solids, exceed the recommended and/or mandatory limits for drinking water. The concentrations of sulfate and total dissolved solids drop markedly in water from wells in excess of 150 feet deep; and for nitrate, in wells in excess of 75 feet deep.

Mound Basin

Shallow ground water (see Table 3) along the coastal margins of the basin are not suitable for most beneficial uses.

Ground waters of the basin are Class 2 to Class 3 for irrigation use. Sulfates and total dissolved solids exceed the recommended and/or mandatory limits for drinking water. Nitrates exceed the recommend limits for drinking water in the depth interval 0 - 400 feet.

Analyses for the two wells 2N/23W-5L1 and -5P1 are given for this basin, although on Plate 2A they are shown as located within the boundaries of the Lower Ventura River Hydrologic Unit. However, an earlier investigation had revealed that, in this area, the San Pedro Formation, which yields water to these wells, appears to be in hydraulic continuity with the Mound Basin and is separated from the overlying

ANALYSES OF GROUND WATER FROM SELECTED WELLS, 1960-64

FILLMORE BASIN

State well number1/	Seal2/	Number of analyses	Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	Boron	TDS
			Average constituents in parts per million								
						Depth 0-75'					
4N/20W-25J1	N.S.	4	229	109	116	506	645	89	58	.82	1,702
-35H2	N.L.	1	218	74	124	354	667	66	65	.80	1,482
-36D1	N.L.	1	252	86	100	391	637	98	95	.35	1,511
Average			231	99	114	461	647	87	65	.74	1,633
						Depth 0-150'					
3N/21W-12D1	N.L.	4	387	124	230	353	1,278	223	31	.45	2,705
-12D2	N.S.	4	473	134	372	399	1,629	304	39	.51	3,285
-12H1*	N.S.	9	131	42	91	261	405	42	9	.69	1,169
4N/19W-32K5*	N.S.	1	110	40	107	226	375	64	11	.45	808
4N/20W-36C2	N.S.	1	299	109	124	444	850	101	82	1.0	1,954
1. Average (All five wells.)			264	83	182	314	868	140	24	.61	1,960
*2. Average (Two wells only.)			129	42	92	258	402	38	10	.67	1,133
						Depth 0-400'					
3N/19W- 6D1*	C.T.	1	127	49	124	275	445	37	13	.23	991
3N/20W- 5D1*	N.S.	6	130	42	40	313	234	28	54	.14	746
4N/19W-30D1	C.T.	1	230	89	79	397	578	80	76	.18	1,449
-30P3	N.S.	2	185	86	123	334	620	45	11	-	1,450
4N/20W-23Q1*	N.S.	4	125	41	48	183	281	81	46	.61	821
-25D1*	N.S.	3	111	30	86	200	274	83	6	1.95	763
-26A2*	C.T.	2	134	38	83	255	323	71	36	.98	887
-26D1*	C.T.	6	116	23	52	232	214	41	36	.33	618
-26F2*	None	1	99	41	35	265	166	47	55	.17	644
-34R1*	N.S.	8	140	44	91	298	380	54	21	.80	1,028
-36D5	N.S.	1	187	72	102	348	584	60	29	.91	1,326
1. Average (All eleven wells.)			135	43	71	270	324	54	33	.64	891
*2. Average (Eight wells only.)			127	38	67	259	288	53	33	.70	826
						Depth 0-670'					
4N/19W-30K1	N.S.	2	211	79	114	286	710	34	10	--	1,506
-30Q2	None	1	187	77	115	334	652	33	19	--	1,452
-32G1*	90'	1	123	45	90	223	432	24	6	.74	924
4N/20W-23Q2*	None	1	112	34	67	249	239	62	25	.76	670
1. Average (Four wells.)			169	63	100	276	549	37	14	.75	1,211
*2. Average (Two wells.)			117	40	78	236	335	42	15	.75	797
						Depth 0-950'					
4N/20W-33C1	None	1	98	21	94	299	227	32	17	.61	638

1/ See Appendix C for explanation of state well numbers.
2/ N.S. Sealing data not shown on well log;
N.L. Well log not available;
C.T. Cable tool drilled well.
* Water quality is believed to be moderately affected by percolation of poor quality ground and/or surface waters. The high nitrate concentrations suggest much of the basin is affected by percolation of irrigation return and/or sewage and domestic waste waters.

TABLE 3

ANALYSES OF GROUND WATER FROM SELECTED WELLS, 1960-64

MOUND BASIN

State well number	Seal[1/]	Number of analyses	Average constituents in parts per million								
			Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	Boron	TDS
					Depth 0-75'						
2N/23W-10B	None	1	774	152	1,363	564	2,080	1,970	25	4.55	8,944
-23L	Test	1	389	317	2,053	574	2,421	2,704	9	2.6	8,420
Average			581	234	1,708	569	2,250	2,337	13	3.57	8,682
					Depth 0-400'						
2N/22W- 8R1	N.S.	1	261	79	214	353	949	110	62	.90	1,894
-10R2	N.S.	1	122	46	118	248	437	58	12	.53	1,014
-16K1	N.S.	10	120	42	138	262	458	53	6	.55	1,070
-17Q1	C.T.	5	174	76	171	280	675	101	49	.63	1,427
-21D2	N.L.	2	185	61	123	276	428	90	20	.65	1,307
-21D3	50'	6	197	104	306	287	1,054	156	34	.96	2,137
Average			160	70	186	276	661	93	25	.69	1,447
					Depth 0-670'						
2N/22W- 7R2	N.S.	1	168	50	132	353	480	72	17	0.50	1,154
- 9L2	N.S.	1	141	41	155	359	444	67	0	0.64	1,144
-16Q1	C.T.	2	202	67	139	320	651	86	28	.74	1,382
-17N2	N.S.	1	159	43	145	334	486	80	0	.84	1,178
-19G1	100'	1	133	34	120	254	420	47	2	.60	960
-20M7	30'	1	142	45	142	281	508	59	0	.61	1,090
-20Q1	C.T.	10	154	47	126	245	504	73	15	.59	1,150
2N/23W-23G1	C.T.	2	120	41	115	234	408	53	.3	.45	882
Average			154	47	130	270	500	70	12	.60	1,135
					Depth 0-950'						
2N/22W-10R1*	C.T.	3	128	36	150	271	473	57	.17	.52	1,039
2N/23W- 5L1	150'	7	235	73	244	390	509	395	7	.89	1,738
- 5P1	N.L.	7	410	112	305	336	524	935	.32	.85	2,908
-13F1*	N.S.	4	138	48	160	344	474	73	1.8	.68	1,138
-14K1	N.S.	2	157	67	296	352	660	225	0	.64	1,691
-14L1*	C.T.	9	155	45	153	465	450	75	1	.56	1,291
-24G1*	N.S.	1	172	49	133	350	504	83	9	.44	1,126
1. Average (For seven wells)			222	66	213	381	497	333	2.14	.71	1,707
*2. Average (For four wells only)			146	45	153	372	463	72	1.51	.58	1,201
					Depth 0-1,675'						
2N/22W-18N1	100'	1	153	46	152	327	496	86	2	.60	1,188
2N/23W-10R1	108'	1	125	50	141	235	508	83	1	.29	1,102
-14M1	118'	3	144	58	157	375	495	80	1.7	.67	1,157
-14N1	N.S.	1	117	41	152	243	475	86	2	.29	1,077
Average			138	52	156	326	494	82	1.7	.53	1,140

1/ Test well.
N.S. Sealing date not shown on well log;
N.L. Well log not available;
C.T. Cable tool drilled well.

* The second average excludes the analyses for wells which are believed to be intruded by sea water.

younger alluvium by a thickness of clay. Therefore, in this area it is considered a part of the Mound Basin.

Oxnard Basin (Pressure Area)

Shallow ground waters (see Table 4A) of the basin are not suitable for most beneficial uses. Ground waters below a depth of 75 feet are Class 1 to Class 3 for irrigation use. However, only in the area of sea-water intrusion within the Oxnard and Mugu aquifers (see Table 4B) are the waters Class 3 for irrigation use.

Concentrations of sulfate and total dissolved solids exceed the recommended and/or mandatory limits for drinking water in wells less than 400 feet deep and in the Oxnard and Mugu aquifers. Concentrations of sulfate, chloride, and total dissolved solids, with few exceptions, exceed the recommended limits for drinking water in wells greater than 400 feet and in aquifers underlying the Mugu aquifer.

Piru Basin

The ground waters of this basin (see Table 5) range from Class 1 to Class 3 for irrigation use. However, they are predominately Class 2 for irrigation use. Magnesium concentrations in water from the depth interval 0-400 exceed the limits for drinking water. Nitrate concentrations exceed the limits for drinking water in one or two wells of all of the depth intervals. Sulfate and total dissolved solids exceed the mandatory limits for drinking water.

TABLE 4A

ANALYSES OF GROUND WATER FROM SELECTED WELLS, 1960-64, BY DEPTH,

OXNARD BASIN (Pressure Area)

State well number	Seal[1/]	Number of analyses	Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	Boron	TDS
			Average constituents in parts per million								
					Depth 0-75'						
1N/22W- 5K2	8'	1	410	242	800	503	3,175	99	--	--	4,978
- 6M1	7'	1	274	327	844	146	2,998	443	--	2.52	5,032
- 7D1	7'	1	355	541	1,760	834	5,680	333	8.0	2.14	9,511
- 8L2	7'	1	394	339	1,240	461	4,035	231	49.0	7.05	6,749
- 9C3	12'	1	288	167	370	425	1,622	111	--	2.41	2,771
-16D3	10'	1	242	117	212	330	1,017	117	4.0	1.27	1,874
-17B2	10'	1	154	35	148	309	433	58	5.6	.58	1,195
-18C1	7'	1	82	19	110	278	33	183	0	.26	705
-22H4	2'	3	428	115	580	16	2,292	254	2.1	1.27	3,938
-23E3	2'	3	519	344	1,430	414	4,655	427	17.0	7.47	8,173
-29B1	N.L.	1	1,411	627	10,291	211	2,751	18,173	1.0	3.5	35,654
1N/23W- 1A2	7'	1	510	134	312	335	1,600	225	--	1.38	3,116
2N/22W- 8C4	Test	1	271	119	150	271	1,026	139	10.0	.92	2,038
-29H1	Test	1	185	49	110	299	530	60	0	.55	1,112
-31B2	16'	1	275	91	295	374	1,186	120	--	1.09	2,154
-32C3	12'	1	180	67	257	340	880	55	--	--	1,779
2N/23W-36A3	Test	1	177	74	370	423	993	117	--	2.01	1,943
Average			383	206	1,109	325	2,324	1,071	8.9	1.50	5,569
					Depth 0-150'						
1N/21W-19R4*	50'	2	118	35	133	371	367	63	12.0	.58	902
1N/22W-15P1	N.L.	3	113	66	105	236	401	118	0.0	.82	1,032
-21G1	N.L.	5	155	52	102	244	390	150	2.4	.64	1,102
-22N5	N.L.	7	187	67	114	243	369	289	.4	.75	1,357
2N/22W-26G1*	25'	1	174	58	122	311	579	53	12	.74	1,240
1. Average (Five wells)			157	59	112	260	386	183	2.8	.71	1,173
*2. Average (Two wells only)			137	43	129	351	404	60	12.0	.64	1,012
					Depth 0-400'						
1N/21W-28N1	N.S.	4	194	87	150	299	320	405	6.9	.42	1,545
2N/21W-18R5*	None	1	101	36	106	305	271	59	7.5	.52	740
2N/22W-29R2*	None	1	151	52	110	256	487	61	19.0	.60	1,090
-36M3*	None	1	176	88	122	290	702	81	0	.68	1,440
1. Average (Four wells)			172	75	134	293	392	260	7.7	.50	1,350
*2. Average (Three wells only)			143	58	113	284	487	67	8.8	.60	1,090
					Depth 0-670'						
1N/21W-19L7	190'	1	121	36	88	253	364	42	0.0	.65	866
-21K1	C.T.	2	37	36	126	280	188	46	.5	.35	636
-28G3	N.S.	1	139	49	140	336	395	124	2.2	.49	1,132
-30A1	C.T.	8	108	37	99	286	319	47	3.4	.64	804
-32A2	Yes	4	59	36	118	239	228	76	.1	.37	686
1N/22W-13K2	35'	1	[illegible]	35	78	257	347	41	0.0	.55	846
2N/22W-31A3	None	1	[illegible]	48	94	220	428	43	5.4	.68	890
Average			93	37	107	271	299	57	3.0	.54	788

TABLE 4A (continued)

ANALYSES OF GROUND WATER FROM SELECTED WELLS, 1960-64, BY DEPTH,

OXNARD BASIN (Pressure Area)

State well number	Seal 1/	Number of analyses	Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	Boron	TDS
			Depth 0-950'								
1N/21W-28N2	250'	4	69	40	228	354	206	232	.1	.66	979
-32C1	85'	6	76	40	124	248	314	101	.6	.43	803
2N/21W-20F1	105'	1	67	24	94	269	171	56	6.0	.35	568
Average			73	39	159	289	262	126	.9	.51	846
			Depth 0-1,583'								
1N/21W- 8F1	55'	1	97	34	109	316	255	59	0.0	.49	756
- 9M1	N.S.	7	83	31	105	341	215	56	.9	.43	681
-16P2	100'	1	88	29	123	296	245	81	1.0	.37	822
-31L1	N.S.	3	81	36	97	264	264	44	0.0	.55	712
1N/22W-17B1	N.S.	5	112	36	87	118	363	43	0.5	.56	809
2N/21W-18H10	45'	1	103	35	141	332	329	68	0.0	.48	910
-19C1	40'	1	106	37	107	258	368	43	0.9	.61	830
Average			94	34	102	288	280	52	.5	.49	751

1/ N.L. Well log not available.
N.S. Sealing data not shown on log.
C.T. Cable tool-drilled well.

* Depth 0 - 150' - the second average excludes the wells whose water quality is believed affected by the intrusion of sea water.

Depth 0 - 400' - analyses of water from well 1N/21W-28N1 (gravel-packed from the ground surface to a depth of 220 feet) have shown high concentrations of mineral constituents since 1938. These high concentrations are believed to be due to the percolation of poor quality surface and shallow ground waters. More recently, the ground water quality is also believed to be affected by the intrusion of sea water. Therefore, the second average excludes the tabulation for this well.

TABLE 4B

ANALYSES OF GROUND WATER FROM SELECTED WELLS, 1960-64, OXNARD BASIN (Pressure Area)

BY AQUIFERS

State well number	Seal 1/	Number of analyses	Average constituents in parts per million								
			Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	Boron	TDS
			Oxnard Aquifer								
1S/21W- 8L2	25'	6	827	768	5,996	242	1,606	16,173	0.0	1.71	24,345
1N/21W- 5P1*	C.T.	1	109	32	104	305	267	66	1.5	.48	795
- 6L2*	C.T.	3	136	45	107	262	446	54	.5	.71	1,024
- 9D2*	60'	1	103	32	87	256	278	52	1.0	.35	720
-18A1*	C.T.	2	116	36	98	284	324	55	0.5	.58	854
-19L6*	50'	1	124	35	90	281	338	45	4.0	.62	835
-20N4*	C.T.	1	124	37	91	284	339	44	5.6	.27	846
-29R4*	C.T.	3	108	47	99	298	336	55	2.5	.65	849
-31A1*	C.T.	6	117	38	92	261	359	39	1.4	.63	842
-32L1*	Yes	5	116	40	108	261	359	66	.4	.69	884
1N/22W- 2K4*	130'	1	194	89	120	225	771	91	2.0	.8	1,558
- 5M1*	C.T.	1	125	49	93	266	412	51	1.5	.7	918
- 6R1*	C.T.	1	209	67	139	251	680	143	0.0	.85	1,434
- 7H1*	C.T.	1	124	38	107	247	413	41	0.0	.65	860
- 8K3*	C.T.	7	111	46	93	252	386	46	0.3	.84	878
- 9H1*	C.T.	11	173	60	114	249	636	73	6.6	.69	1,229
-14R4*	69'	1	128	34	95	244	390	38	0.0	.66	860
-15B3*	C.T.	7	131	52	101	265	435	58	8.2	.66	1,016
-16Q1	C.T.	6	647	223	601	176	519	1,933	2.7	.65	7,079
-17M3*	Yes	10	118	42	95	244	393	42	2.3	.63	865
1N/22W-18P1*	C.T.	5	118	44	96	246	392	43	0.5	.74	884
-19H1	C.T.	7	636	315	1,615	77	662	3,989	0.3	.95	8,398
-20E1	C.T.	8	1,030	457	2,036	93	826	5,436	0.7	.83	11,689
-21J2	C.T.	5	1,244	389	526	222	672	3,527	0.0	.79	8,222
-22H2	90'	6	233	74	134	239	426	376	0.7	.73	1,618
-23E2	82'	8	145	59	112	248	365	185	0.3	.77	1,118
-25C2*	C.T.	1	35	89	99	257	358	45	0.0	.56	835
-26A1*	C.T.	2	138	46	107	262	438	54	8.0	.74	1,005
-27R1*	Yes	13	109	37	93	269	323	48	1.4	.59	817
-28B1	C.T.	13	799	325	731	68	614	3,174	2.9	.73	6,641
1N/22W-35G1*	N.S.	5	66	23	82	333	87	47	1.8	.62	494
-36K1	C.T.	10	161	59	165	276	288	317	2.2	.65	1,328
2N/21W-18H1*	C.T.	5	165	177	138	299	544	82	18.6	.61	1,231
-19B2*	C.T.	1	135	68	113	291	499	68	1.0	.66	1,078
-29P3*	C.T.	1	109	46	117	261	349	81	0	.48	926
-30R3*	C.T.	1	178	47	132	317	581	82	3.1	.27	1,253
-25R2*	C.T.	1	214	79	137	296	735	91	2.0	.80	1,537
-26Q1*	C.T.	1	158	76	178	273	708	84	5.0	.78	1,485
-35B1*	C.T.	1	149	158	153	275	611	66	2.8	.84	1,291
2N/23W-25Q1*	C.T.	7	139	40	131	248	496	62	6.9	.52	1,052
-35B1*	C.T.	3	108	43	128	214	454	56	0.4	.58	957
1. Average (41 wells)			314	141	802	229	502	1,408	2.7	.72	3,385
*2. Average (32 wells only)			120	49	100	250	390	54	3.4	.61	912

TABLE 4B (continued)

ANALYSES OF GROUND WATER FROM SELECTED WELLS, 1960-64, OXNARD BASIN (Pressure Area)

BY AQUIFERS

State well number	Seal	Number of analyses	Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	Boron	TDS
			Average constituents in parts per million								
			Oxnard and Mugu Aquifers								
1N/21W-20R1	C.T.	2	178	54	128	302	509	80	51.0	.52	1,223
-28F2	C.T.	5	124	52	130	344	357	105	3.7	.44	1,013
-29C1	100'	1	116	47	200	281	490	116	1.0	.75	1,174
-30F2*	C.T.	1	68	32	104	298	205	39	0.0	.60	628
-31L2	57'	1	110	37	95	278	232	117	8.1	.13	794
-32G1	N.S.	6	183	67	165	284	352	342	2.9	.59	1,459
1N/22W- 2N3*	C.T.	2	197	58	134	236	691	79	.2	.74	1,355
-15C1	C.T.	5	143	51	105	249	435	99	1.9	.65	1,029
-19B3*	192'	1	113	37	89	249	335	42	--	.54	865
-21L1	C.T.	13	714	241	598	89	458	2,473	3.3	.67	5,256
-22F2*	Yes	3	140	42	101	263	427	52	4.8	.80	937
-27A2	97'	5	157	65	104	252	371	204	0.0	.67	1,150
2N/22W-31N1*	C.T.	1	79	61	95	245	389	36	0.0	.75	828
2N/23W-36A1*	C.T.	9	128	38	106	261	432	55	0.2	.56	1,013
1. Average	(14 wells)		278	96	233	230	420	683	4.2	.61	2,080
*2. Average	(6 wells only)		131	42	107	259	440	55	1.0	.63	997
			Mugu Aquifer								
1N/21W-21N1*	C.T.	3	107	31	92	278	281	48	.9	.37	926
-32Q1*	Yes	5	59	39	117	284	249	51	0.0	.40	725
1N/22W-20B1	C.T.	7	342	215	1,545	248	695	2,959	1.9	.98	6,195
-21B1	C.T.	5	269	80	131	218	400	487	1.3	.61	1,783
-26M3*	C.T.	2	117	41	103	265	377	52	0.0	.37	923
1. Average	(5 wells)		204	103	579	255	441	1,075	1.0	.63	2,751
*2. Average	(3 wells)		85	37	107	279	284	51	.3	.39	824
			Mugu and Hueneme Aquifers								
1N/22W-18L2	280'	1	115	38	91	253	349	43	--	0.38	889
			Hueneme Aquifer								
1N/22W-19A1	132'	6	110	38	87	229	355	51	.6	.65	819
			Hueneme and Fox Canyon Aquifers								
1N/22W- 4F4	460'	2	124	37	89	248	378	42	0.5	.62	889
- 5G3	550'	2	117	40	87	251	363	37	0.9	.62	836
-16D4	480'	1	120	40	88	243	373	41	0.0	.66	840
-21B3	450'	2	116	37	117	240	388	37	0.0	.56	864
Average			119	39	96	246	376	39	.4	.61	860

TABLE 4B (continued)

ANALYSES OF GROUND WATER FROM SELECTED WELLS, 1960-64, OXNARD BASIN (Pressure Area)

BY AQUIFERS

State well number	Seal	Number of analyses	Average constituents in parts per million								
			Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	Boron	TDS
			Fox Canyon Aquifer								
1N/22W-20E2	130'	7	134	31	94	252	387	42	0.8	.54	931
-27B4	Yes	11	111	39	109	213	409	50	1.8	.46	901
-29A4	540'	6	113	26	113	234	329	37	3.4	1.58	743
			120	34	105	229	383	45	1.9	.76	870
			Fox Canyon and Grimes Canyon Aquifers								
1N/22W-27R2	Yes	12	94	38	104	255	322	46	2.7	.52	794
			Grimes Canyon Aquifer								
1S/21W- 8L1	440'	5	48	32	197	315	131	192	0.0	.63	773
1N/21W-32A1	460'	5	79	53	197	293	317	186	.7	.54	1,047
Average			64	42	197	303	224	190	.3	.59	910

1/ N.L. = Well log not available.
Test = Test well.
N.S. = Sealing data not shown on log.
C.T. = Cable tool drilled well.

*The second average excludes the wells whose water quality is believed affected by the intrusion of sea-water or impaired by the percolation of water from the sea-water intruded Oxnard aquifer or both. This table shows the aquifers in descending order.

TABLE 5**

ANALYSES OF GROUND WATER FROM SELECTED WELLS, 1960-64

PIRU BASIN

State well number	Seal 1/	Number of analyses	Average constituents in parts per million								
			Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	Boron	TDS
						Depth 0-150'					
4N/19W-26J1	N.L.	1	257	120	190	543	950	51	42	.14	2,008
-33J1	N.L.	2	343	89	168	363	1,030	87	96	1.38	2,227
Average			315	100	175	423	1,003	75	78	.97	2,154
						Depth 0-400'					
4N/19W-25C1	N.S.	1	353	113	208	500	1,149	74	116	0.55	2,439
-26P2*	N.L.	1	92	164	164	448	717	57	58	1.07	1,720
-26Q1*	N.S.	2	199	146	152	400	981	53	30	.66	1,886
-27P2*	None	1	239	104	124	423	829	46	24	.79	1,727
-34B1*	N.S.	1	234	93	123	409	759	46	46	.21	1,594
-34C3*	None	1	183	74	102	354	577	35	44	.23	1,291
-35C1*	N.L.	1	77	142	146	400	615	53	71	.95	1,498
1. Average (Seven wells)			197	123	146	417	826	52	52	.64	1,755
*2. Average (Six wells only)			175	128	137	405	682	49	43	.64	1,657
						Depth 0-650'					
4N/19W-25C2	None	3	190	93	119	299	779	48	22	1.07	1,495
-25E2*	None	3	161	84	117	292	652	46	15	.78	1,319
-25M2*	N.L.	10	148	62	92	228	535	45	23	.94	1,102
-26H1*	83'	2	121	73	108	242	533	42	7	.88	1,544
-26J3*	N.S.	2	197	90	110	281	720	49	56	.57	1,441
-33D4*	C.T.	4	144	61	63	155	514	29	13	.69	1,065
-33E1*	C.T.	5	140	59	95	249	519	32	10	.76	1,106
1. Average (Seven wells)			153	70	96	254	580	41	20	.84	1,191
*2. Average (Six wells only)			149	67	93	249	556	40	16	.82	1,148

1/ N.L. Well log not available.
N.S. Sealing data not shown on well log.
C.T. Cable tool drilled well.

* Do not include the wells believed to be affected by percolation of poor quality surface waters of Hopper Canyon and irrigation return water.

**High nitrate concentrations shown in all of the depth intervals suggest percolation of domestic waste and/or irrigation return waters.

Pleasant Valley Basin

Wells drilled in the basin generally exceed a depth of 150 feet. Therefore, in Table 6, the depth interval 0-200 feet was used to determine the ground water quality in the shallow water-bearing zones of the basin.

Ground waters of the basin are Class 1 to Class 3 for irrigation use. Ground waters below a depth of 400 feet are Class 1 to Class 2 for irrigation use.

Sulfates and total dissolved solids exceed the recommended and/or mandatory limits for drinking water. Chlorides in ground water from depths less than 400 feet commonly exceed the recommended limits for drinking water. Nitrates in ground water from two wells exceed the recommended limits for drinking water (see footnotes, Table 6).

Santa Paula Basin

Wells drilled in the basin generally exceed a depth of 75 feet. Therefore, in Table 7, the depth interval 0-150 feet was used to determine the ground water quality in the shallow water-bearing zones of the basin.

Ground waters of the basin are Class 1 to Class 3 for irrigation use.

Sulfates and total dissolved solids generally exceed the recommended and/or mandatory limits for drinking water.

Simi Basin

Wells drilled in the basin generally exceed a depth of 150 feet. Therefore, in Table 8, the depth interval 0-200 feet was used to determine the water quality in the shallow water-bearing zones of the basin.

TABLE 6

ANALYSES OF GROUND WATER FROM SELECTED WELLS, 1960-64

PLEASANT VALLEY BASIN

State well number	Seal 1/	Number of analyses	Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	Boron	TDS
			Average constituents in parts per million								
			Depth 0-200'								
1N/21W-11R1	N.S.	1	254	124	247	466	787	341	0.0	0.74	2,274
-12E4	C.T.	2	223	113	249	226	816	367	0.1	.24	2,091
-27H1	C.T.	1	168	73	165	336	427	262	30.0	.42	1,364
2N/21W-32Q2	C.T.	1	124	43	122	312	314	102	2.5	.26	930
Average			199	93	206	313	631	288	6.5	.38	1,750
			Depth 0-400'								
1N/21W- 1A1	C.T.	1	228	128	237	397	627	447	2.5	.39	2,159
- 1N1	C.T.	3	372	156	295	281	1,206	495	9.2	.60	2,930
-12C3	42'	1	199	98	220	405	599	294	.5	.56	1,770
-15D1	42'	1	69	27	103	305	163	64	1.0	.32	600
2N/21W-23R2*	C.T.	7	107	29	90	227	204	84	72.0	.31	751
-33A1	None	4	267	88	219	255	960	206	4.0	.66	2,072
-33B1	60'	1	126	34	75	237	159	163	31.0	.20	800
Average			198	73	168	266	580	215	32.4	.48	1,544
			Depth 0-670'								
1N/21W- 2K1	N.S.	1	164	74	189	275	574	186	14.0	.55	1,485
2N/20W-27D4	None	1	97	78	129	486	239	136	3.0	.18	1,000
2N/21W-28M2	None	1	90	31	103	278	167	116	8.0	.22	670
-36F1	Yes	2	194	58	175	227	330	93	19.1	.31	1,427
-36N4	C.T.	6	160	61	161	244	503	191	4.6	.53	1,323
Average			155	65	158	269	424	161	8.2	.48	1,268
			Depth 0-950'								
1N/21W- 2J3	50'	1	268	92	213	332	765	294	33.0	.84	2,070
-14C1	24'	1	108	39	120	272	306	110	.6	.22	901
-14F3	70'	1	241	30	159	340	445	227	0.0	.44	1,470
-15C1	N.S.	1	186	57	154	269	513	188	8.2	.58	1,430
-15H1	N.L.	1	162	56	188	343	504	174	0.0	.65	1,404
-15Q1	N.S.	5	76	44	154	317	220	155	0.7	.34	879
-22B2	None	1	58	49	124	265	195	131	0.6	.30	762
-22H1	N.L.	1	148	57	154	339	407	166	0.0	.58	1,210
2N/20W-19M4	100'	2	57	15	56	163	122	22	0.0	--	425
-30C1	C.T.	3	170	80	310	327	794	243	.5	.89	1,861
-30H1	C.T.	2	86	61	267	340	336	294	0.0	.74	1,267
2N/21W-23R3	65'	6	90	34	130	218	315	86	1.1	.37	819
-27G1	N.S.	1	93	32	153	338	298	78	0.0	.43	562
-27M4	None	1	83	46	162	266	294	149	7.0	.42	880
-35K1*	None	2	136	56	236	304	499	209	234.0	.78	1,554
Average			115	41	173	262	380	158	18.3	.53	1,106

TABLE 6 (continued)

ANALYSES OF GROUND WATER FROM SELECTED WELLS, 1960-64

PLEASANT VALLEY BASIN

State well number	Seal 1/	Number of analyses	Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	Boron	TDS
					Depth 0-1,175'						
1N/21W- 2P2	None	1	96	57	154	329	252	185	0.5	.36	990
- 3J1	53'	1	101	53	176	315	390	140	0.0	.53	1,128
- 3L1	N.S.	7	94	29	98	243	254	72	2.2	.35	768
-22L1	185'	1	67	70	188	354	268	209	0.0	.53	1,061
2N/20W-19M3	N.S.	1	98	37	131	184	325	88	--	--	890
-31F2	60'	1	96	95	175	339	376	255	0.0	.54	1,280
2N/21W-33P1	Yes	1	258	86	184	437	709	210	1.7	.83	1,830
-33P2	88'	1	80	30	134	324	192	106	0.0	.46	766
-35E1	C.T.	1	207	8	219	317	472	186	2.0	.53	1,311
-36E3	150'	2	159	62	222	263	597	185	0.4	.69(1)	1,519
Average			116	45	147	284	350	132	1.3	.46	1,039

1/ N.S. Sealing data not shown on well log.
C.T. Cable tool drilled well.
N.L. Well log not available.

* Depth 0-410' - mineral analyses have shown high concentrations of nitrate since 1954. The source of the nitrates is believed to be primarily percolation of irrigation water charged with nitrogenous fertilizer.

Depth 0-95 ' - A mineral analysis of a water sample collected on March 17, 1964, for this well shows the concentration of NO_3 to be 469 ppm. Mineral analyses of water samples prior to and after March 17, 1964, show the highest concentration of NO_3 to be 6.2 ppm. It is believed that irrigation water, heavily charged with nitrogenous fertilizer, had entered the well casings prior to sampling.

TABLE 7

ANALYSES OF GROUND WATER FROM SELECTED WELLS, 1960-64

SANTA PAULA BASIN

State well number	Seal 1/	Number of analyses	Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	Boron	TDS
			Average constituents in parts per million								
					Depth 0-150'						
2N/22W- 1M1	N.S.	4	128	44	87	226	410	56	.4	.39	918
- 1M2	C.T.	1	150	36	84	317	362	53	3.7	.11	895
3N/21W-16F2	N.L.	1	196	64	99	366	530	82	12.0	.65	1,274
Average			143	46	88	266	422	60	3.7	.38	973
					Depth 0-400'						
2N/22W- 2K6*	Yes	1	135	37	93	326	350	48	0.0	.45	886
-10A2*	None	1	93	16	162	196	410	48	1.0	.37	870
3N/21W- 9R3*	C.T.	5	111	36	88	258	333	38	0.1	.45	802
-11J1	C.T.	1	317	95	129	409	868	158	38.0	.50	2,092
-15C2*	C.T.	5	151	56	95	282	457	61	21.0	.44	1,073
-16K1	C.T.	5	188	58	116	313	565	78	7.0	.47	1,279
-16K2	C.T.	4	213	69	158	343	688	111	2.1	.79	1,548
-16P1	C.T.	1	223	64	173	363	730	81	0.0	.92	1,564
-16R2	C.T.	3	197	67	137	309	635	103	3.5	.42	1,392
-17P1	None	1	228	69	243	424	851	110	15.0	1.10	1,862
-30F1*	C.T.	1	200	54	95	331	532	81	0.0	.48	1,230
-30H3*	C.T.	1	125	42	140	284	445	53	0.0	.44	1,032
3N/22W-36H1*	210'	1	267	22	148	360	614	74	15.0	.78	1,428
1. Average (Thirteen wells)			176	54	124	309	541	76	7.6	.54	1,237
*2. Average (Seven wells only)			142	42	106	281	379	55	8.1	.46	988
					Depth 0-670'						
3N/21W-15C5	C.T.	1	138	40	86	307	358	40	10.0	.42	910
3N/22W-34H2*	C.T.	1	116	56	211	394	473	110	4.0	.65	1,220
Average			127	48	148	350	415	75	7.0	.53	1,065
					Depth 0-875'						
2N/22W- 2K7	140'	1	129	35	88	289	331	38	1.0	.43	856
3N/21W-19H6*	C.T.	1	168	53	115	317	510	64	6.0	.64	1,130
3N/22W-35Q1*	100'	1	356	88	176	441	1,107	92	11.0	.64	2,264
-36K4	Yes	1	160	45	77	309	386	64	1.0	.36	983
Average			203	55	114	339	583	64	4.7	.52	1,308

1/ N.S. = Sealing data not shown on well log.
C.T. = Cable tool drilled well.
N.L. = Well log not available.

* Depth 0 - 400', the second average excludes the wells believed to be affected by percolation of irrigation return waters and/or sewage waste water from the Santa Paula Sewage Disposal Plant. Higher than average nitrate concentration shown for 3N/22W-36H1 suggests the quality of the water may be impaired by percolation of return irrigation water.

Depth 0 - 670', 3N/22W-34H2 may be affected by percolation of return irrigation water.

Depth 0 - 875', 3N/21W-19H6 and 3N/22W-35Q1 may be affected by percolation of sewage waste waters from the Limoneira Sewage Disposal Plant and/or irrigation return water.

TABLE 8**

ANALYSES OF GROUND WATER FROM SELECTED WELLS, 1960-64

SIMI BASIN

State well number	Seal[1/]	Number of analyses	Average constituents in parts per million: Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	Boron	TDS
			Depth 0-200'								
2N/18W- 8G4	None	1	237	84	187	337	773	157	0.0	1.10	1,716
- 8Q3	Yes	1	339	21	202	366	821	149	0.0	1.18	1,810
Average			288	52	194	351	797	153	0.0	1.14	1,763
			Depth 0-400'								
2N/18W- 1P2	N.S.	2	232	85	164	237	839	123	2.7	--	1,763
- 8L5	None	1	248	84	198	368	840	146	0.3	0.70	1,870
- 9F1	None	1	364	00	173	312	759	138	23.0	0.94	1,600
- 9R3	80'	1	191	60	127	273	610	86	14.0	0.50	1,330
-11A6	40'	1	170	63	147	278	598	95	0.0	0.77	1,420
-11M6	None	1	221	73	172	274	787	131	17.0	1.16	1,694
-16C3	None	1	171	43	146	268	541	90	1.1	0.38	1,232
-17B6	None	1	188	55	136	325	548	106	0.5	0.38	1,285
Average			224	61	158	286	707	115	6.8	.69	1,551
			Depth 0-670'								
2N/18W- 1M3	N.S.	5	269	119	262	374	1,067	211	7.3	1.74	2,347
- 4R2*	None	1	227	80	200	367	757	145	9.5	.89	1,748
- 8J1*	None	1	192	94	153	299	708	131	22.0	.40	1,499
- 9A2*	None	1	238	89	168	301	843	155	6.0	1.30	1,770
-10A2*	55'	2	188	52	121	287	546	90	5.9	.56	1,377
-11A5*	100'	1	197	67	142	290	651	97	31.0	.70	1,430
-11A7*	None	1	136	47	113	293	355	99	18.0	.77	1,045
-11B2*	N.S.	3	211	89	192	343	795	128	16.0	1.20	1,764
-11B4*	N.S.	1	193	102	177	332	788	118	29.0	1.04	1,710
1. Average (Nine wells)			221	90	193	335	807	148	13.2	1.16	1,811
*2. Average (Eight wells only)			199	77	161	317	689	119	15.9	.93	1,568
			Depth 0-735'								
2N/18W- 3L2	None	1	214	101	219	366	835	166	9.1	.93	1,861
- 3L3	None	1	164	35	178	329	467	107	32.0	.84	1,160
Average			189	68	198	347	651	136	20.5	.88	1,510

1/ N.S. = Sealing data not shown on well log.

* 2N/18W-1M3 is believed affected by percolation of poor quality surface water from Tapo Creek.

** High nitrate concentrations in many of the wells shown above suggest percolation of sewage and domestic waste waters and/or irrigation return waters.

Ground waters of the basin are Class 1 to Class 3 for irrigation use.

Sulfates and total dissolved solids exceed the recommended and/or mandatory limits for drinking water.

Factors Influencing Water Quality

Man's activities usually exert an effect upon the quality of water. Among the adverse activities in Ventura County are the disposal of wastes; return of irrigation water; overdraft of the basins; improper construction, destruction, and sealing of water wells. Other factors exerting influence are : (1) introduction of water from the Colorado River, which is of a different chemical composition than the native ground water, and (2) degradation from natural sources. These contributors to water quality, plus the measures that have already been undertaken to control impairment, are discussed in this section.

Factors from Man's Activities

In fiscal year 1964-65, approximately 12,000 acre-feet of softened Colorado River water was imported into the County. It was primarily distributed for use in Simi and Conejo Basins. The imported water is sodium sulfate in character, and its total dissolved solids concentration averages about 700 ppm.

Although at present, waste disposal practices are strictly regulated by water quality control agencies, uncontrolled waste disposal practices in the past undoubtedly continue to affect the quality of ground waters. Irrigation return water and the controlled disposal of sewage and industrial waste pollutants continue to add to the deterioration

of the quality of the waters. Although the mineral quality of sewage and industrial waste waters is regulated and must meet prescribed limits of concentration, the discharges are generally considerably inferior in mineral quality to waters yielded by the deeper aquifers. In some instances, percolation to the subsurface sediments occurs when untreated sewage and industrial wastes are discharged to holding ponds and unlined sumps.

Along the coastal margins, ground water basins have been intruded by sea water as a result of overdraft conditions (Figure 3). This is caused by the reversal of the natural seaward ground water gradient due to extractions exceeding the ground water replenishment. At present, intrusion of the Oxnard aquifer continues to affect increasingly larger areas of the aquifer extending farther inland from the Port Hueneme and Point Mugu areas. 1/ In addition, the impaired waters of the Oxnard aquifer may be affecting the quality of the underlying Mugu aquifer in the vicinity of Port Hueneme and the lower Pleistocene deposits underlying the mouth of the Ventura River show indications of sea-water intrusion.

Improper construction, destruction, and sealing of water wells may allow the interchange of poor quality waters. This interchange of water may be between aquifers or from the surface to the aquifers or both. Along the coastal margins of the basins, these problems are rapidly becoming more serious as intrusion of sea water continues to encompass a greater number of wells and as older well casings deteriorate and the

1/ In the study reported in DWR Bulletin No. 63-1, "Sea-Water Intrusion: Oxnard Plain of Ventura County," it was found that sea water is advancing into the Oxnard aquifer at the rate of about 1,000 feet per year at Port Hueneme and at a slower rate at Point Mugu. Since that study, the United Water Conservation District and the Department have undertaken cooperative efforts to control the movement, as are discussed later in this chapter.

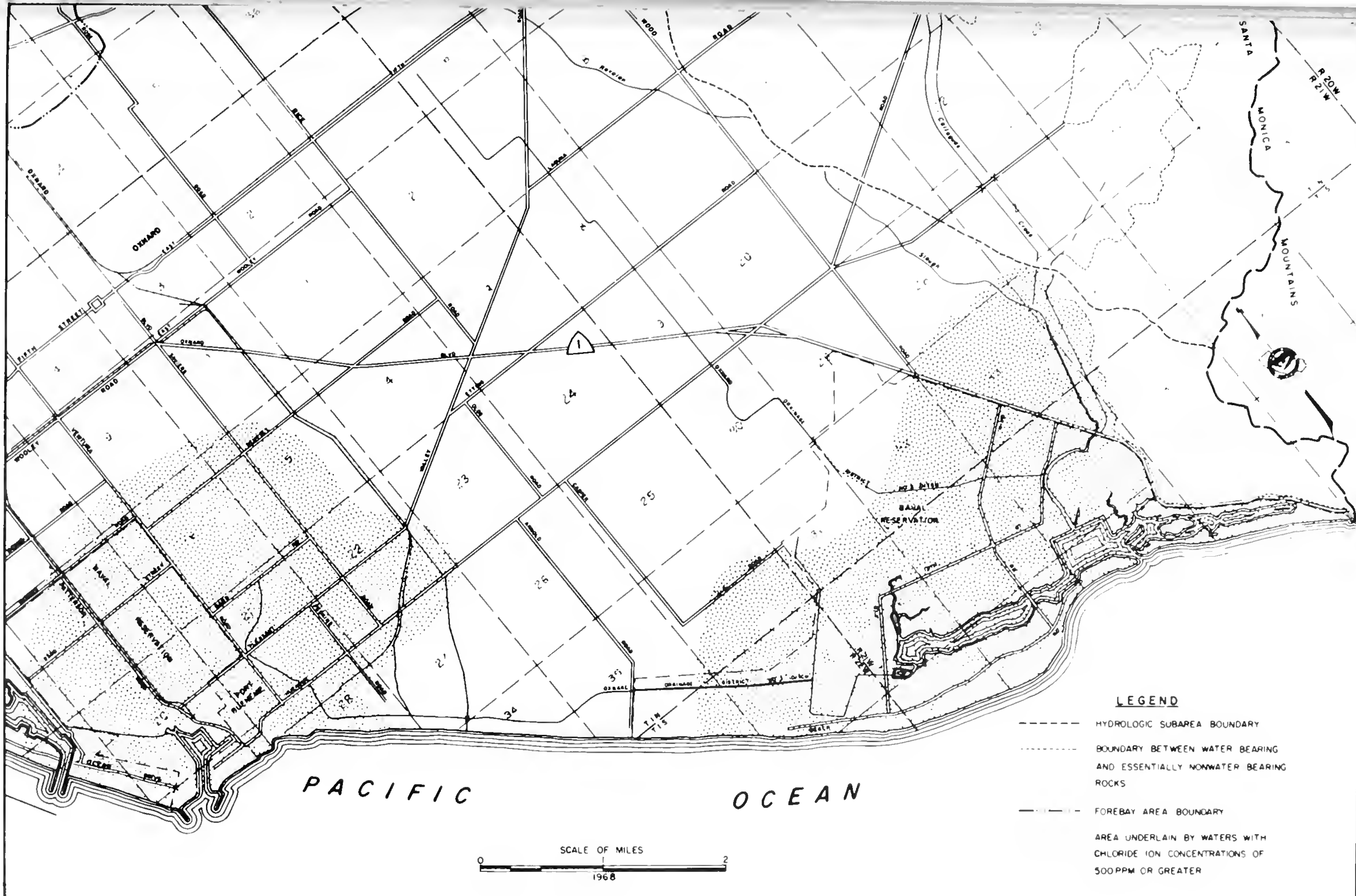


Figure 3 — AREAS OF SEA WATER INTRUSION, OXNARD BASIN (PRESSURE AREA)

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT, 1968

drilling of new wells continues.

Water quality degradation can occur as a result of an adverse salt balance created by man's activities or by natural conditions. An adverse salt balance can occur when the soluble salts entering a basin are greater than the soluble salts leaving a basin.

A potential source of impairment to the quality of water is the decomposable refuse deposited in dumps which have since been covered. Under certain conditions, water coming in contact with this buried refuse becomes degraded and, where conditions permit, the impaired water moves into adjacent beds of sand and gravels.

Factors from Natural Causes

Sources of quality degradation include connate waters, which are probably being encountered in water wells and natural seeps occurring in the highland areas. Connate waters are commonly ocean waters in sediments that had been deposited in the geologic past. These ocean waters have not been replaced or flushed by fresh water. Connate waters, when they occur in a basin, are commonly associated with the lowest sediments of the basin and the older pre-Quaternary sediments.

Impairment to the ground water quality in the northwestern portion of Simi is in large part a result of events in the geologic past. The following is quoted from a report published in 1933 by the Division of Water Resources of the California Department of Public Works (Bulletin No. 46, "Ventura County Investigation"):

> "The channel leading out of Simi Valley varies from 65 to 85 feet in depth and well logs show that a shallow lake existed at the lower end. This lake was gradually filled with vegetation and covered with silt and clay. Water evaporating from this

marshy area resulted in a concentration of salts, so that the water in wells in the lower end of Simi Valley is of very poor quality. Evaporation of rising water is still increasing the mineral concentration, and there is not enough surface flow or underflow to wash this concentration out of the tight alluvium."

Sespe and Piru Creeks receive small flows of water with high boron concentrations originating from past mining operations. In addition, Piru Creek is degraded by boron originating in colemanite deposits in Lockwood Valley.

Control Measures to Protect Quality

Measures to protect the ground water from further impairment include the adoption of regulations governing waste-disposal methods, implementation of artificial ground water replenishment, importation of good quality water, construction of barrier projects to prevent sea-water intrusion, and formulation of water well construction, destruction, and sealing standards.

Actions in recent years by government, industry, and private interests have brought about regulatory measures for controlling waste discharges that have helped to minimize the threat to ground water quality from this source. At present, all existing waste discharges and those in the planning stage must conform to requirements of the regional water quality control boards. Additional water quality control is afforded by the various health departments.

Recently, an experimental well extraction-type barrier to sea-water intrusion was constructed by this Department in a portion of the coastal margin of Oxnard Plain Basin. The barrier is now being tested by the United Water Conservation District, with technical assistance from this Department, in accordance with a written agreement between the two agencies. On the basis of the findings obtained from this project, the barrier may be extended by local agencies.

A contract between the Department of Water Resources and Ventura County Flood Control District provides for a water supply whose initial delivery date to the District it is estimated may be 1980. The imported water furnished by the California Water Project will be of high quality. For example, concentrations of total dissolved solids on a monthly average may not exceed 440 ppm and the average for any 10-year period may not exceed 220 ppm. Deliveries by 1980 will be 1,000 acre-feet, increasing to 20,000 acre-feet by 1990.

CHAPTER IV. WATER WELL STANDARDS - VENTURA COUNTY

Water well standards are intended to prevent impairment of water quality that results from improperly constructed wells, from defective wells, or from inadequately destroyed wells. The standards apply not only to wells in the planning stage, but also to those now in use that require modification and to those that are to be destroyed.

Bulletin No. 74, "Water Well Standards: State of California", presents certain standards that are applicable under all conditions; in addition, it gives other standards that are designed for specific subsurface geologic conditions. Bulletin No. 74-9 is confined to a discussion of this second group of standards as they apply to conditions in Ventura County.

Because of the varying conditions in different parts of Ventura County, the County has been divided into three zones with specific standards established for each. The three zones are shown in Figure 4.

For Zone I, which includes much of the County, the general water well construction and destruction standards contained in Bulletin No. 74 are recommended. However, in some areas, notably in the northern basins of the County, paucity of data prevents the detailed investigation required for the determination of more specific well construction and sealing standards. Hence, the northern basins are included in Zone I until sufficient data are available to determine whether more specific water well construction and sealing standards will be necessary.

Water Well Construction Standards

The deeper aquifers of the study area contain better quality water than do the shallower aquifers. Where the quality of water in

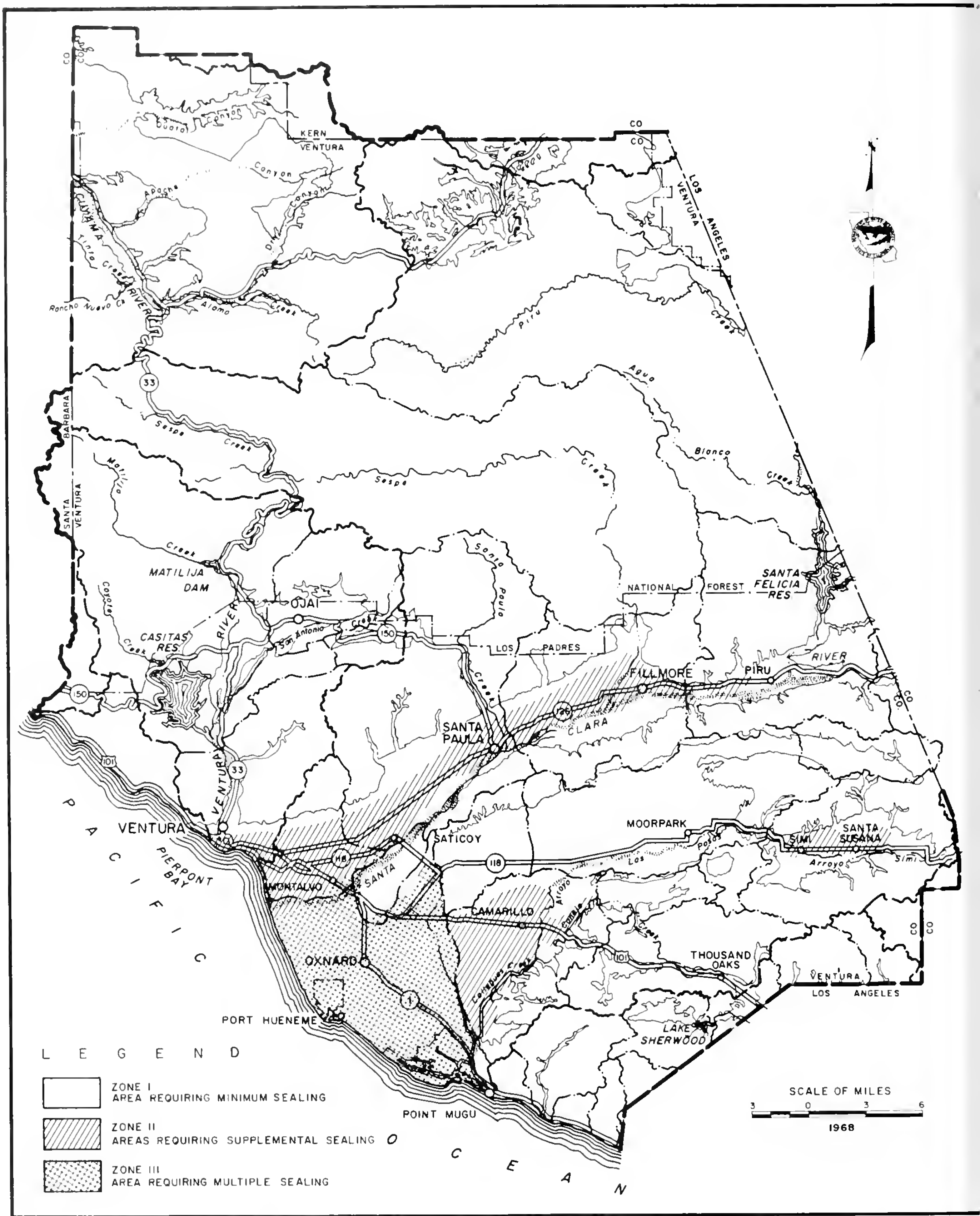


Figure 4 - AREAS OF RECOMMENDED SEALING STANDARDS

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT, 1968

these upper aquifers is so poor that movement of this water into lower aquifers will impair the quality of water of the latter, measures must be taken to seal off the upper aquifers in water wells.

Zone II

The annular space in all wells in Zone II should be sealed from the surface down to a depth sufficient to prevent shallow, poor quality ground water from entering them (See Figure 5). Adequate base-sealing elevations are shown on Plates 4A and 4B.

Zone III

Zone III encompasses Oxnard Basin (Pressure Area). In this zone, sea water has intruded the Oxnard aquifer and, more recently, the Mugu aquifer.

Specific standards for Zone III include:

1. Sealing requirement recommended for Zone II.

2. The annular space in all wells penetrating below the base of the Oxnard aquifer should also be sealed from the base of the Oxnard aquifer to a depth of 20 feet below the base (See Figure 5). Lines of equal elevation on the base of the Oxnard aquifer are shown on Figure 1.

3. In addition to the above, the annular space in all wells penetrating below the base of the Mugu aquifer should be sealed from the base of the Mugu aquifer to a depth of 20 feet below the base (See Figure 5). Lines of equal elevation on the base of the Mugu aquifer are shown on Figure 2.

4. If the well is to obtain water from the Mugu aquifer or lower formations, no perforations should be made opposite the Oxnard aquifer.

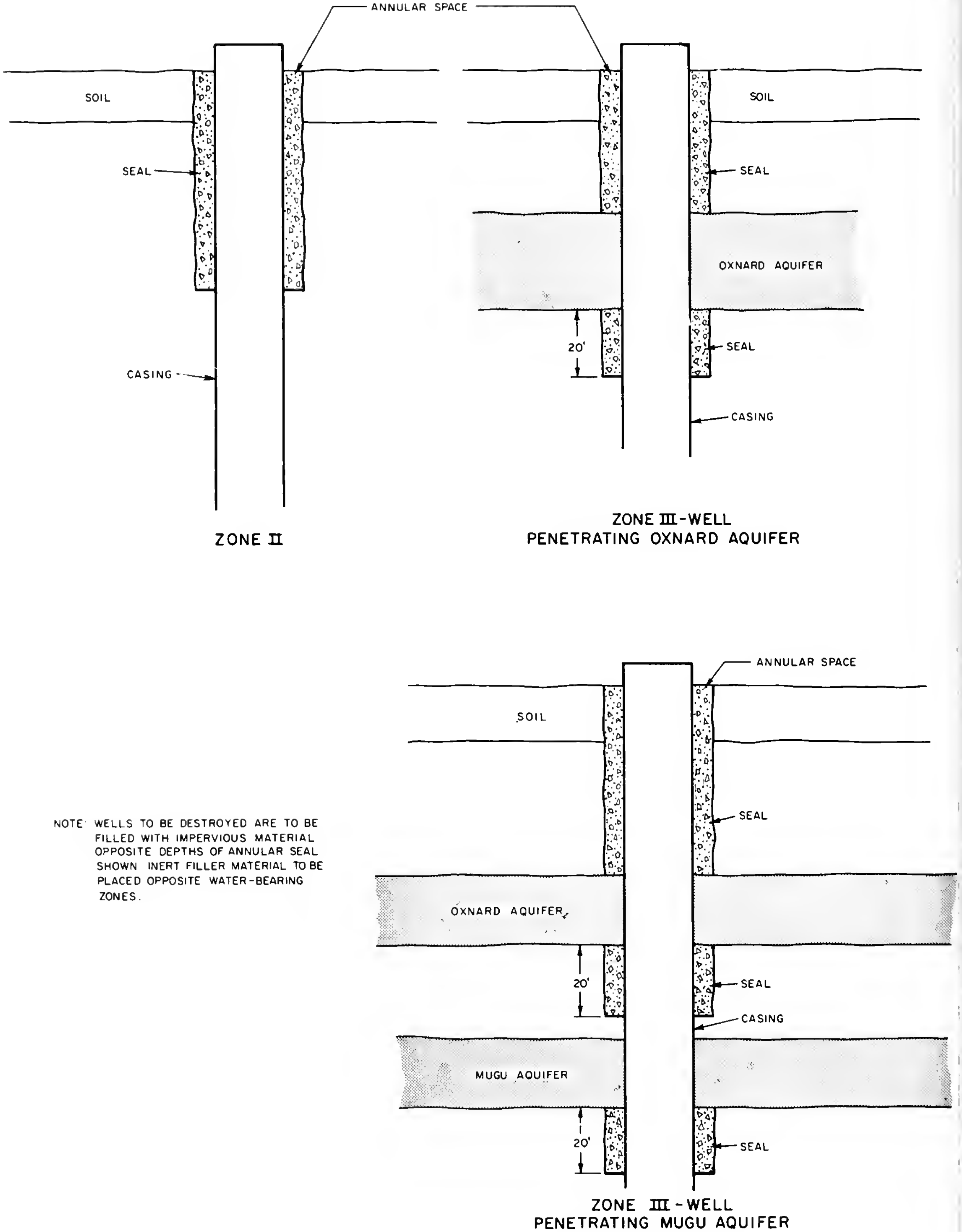


Figure 5. SEALING CONDITIONS IN ZONES II AND III

Water Well Modification Standards for Zone III

The annular space in existing water wells--whether idle or in use--that are within areas intruded by sea water in the Oxnard Basin (Pressure Area) should be sealed so as to prevent the introduction of such waters into lower producing formations. In addition, wells in areas adjacent to the sea-water-intruded portions which are showing increased impairment of quality should have this protection. However, only in wells penetrating aquifers below the Oxnard aquifer is it necessary to seal off these upper (shallow) aquifers and only under the conditions outlined below:

1. The well is located within or adjacent to the areas of sea-water intrusion in the Oxnard Basin (Pressure Area) shown in Figure 3.

2. The well penetrates an aquifer or aquifers below the Oxnard or Mugu aquifers.

3. Neither the Oxnard nor Mugu aquifer is sealed off from the underlying aquifer or aquifers.

4. In the case of a well penetrating only to the Mugu aquifer, the Oxnard aquifer should be sealed off.

Water Well Destruction Standards 1/

In portions of the area of investigation, specific standards, in addition to the standards described in Bulletin No. 74, are needed to

1/ Before any well is destroyed, contact should be made with either the Division of Water Resources of the Ventura County Department of Public Works, the U. S. Geological Survey, or the California Department of Water Resources. In this way, these agencies will be given the opportunity of considering the well for possible monitoring of ground water conditions.

ensure the protection of the quality of ground water when a water well is destroyed. These standards are concerned with sealing off the zones that have been identified as being in areas that contain ground water of impaired quality.

A well that no longer serves a useful purpose or has fallen into such a state of disuse and disrepair that it may become a source of degradation to ground water quality should be destroyed in a manner that will prevent such impairment. Basically, a seal is constructed in the well to prevent degraded waters from reaching good quality ground water via the water well.

Zone II

In Zone II, all wells to be destroyed shall be filled and sealed with impervious sealing material to the elevations shown on Plates 4A and 4B. The remainder of the well shall be filled with clay, sand, or other suitable inorganic material (See Figure 5).

Zone III

Requirements for destroying wells in Zone III are:

1. Compliance with requirement specified for Zone II.

2. If the well to be destroyed penetrates below the Oxnard aquifer, but not below the Mugu aquifer, impervious sealing material shall also be placed in the interval from the base of the Oxnard aquifer down to at least 20 feet below the base (See Figure 5). Inert filler material may be placed opposite the water-bearing zones. Elevations on the base of the Oxnard aquifer are shown on Figure 1.

3. In addition to the above, if the well to be destroyed penetrates below the Mugu aquifer, impervious sealing material shall also be placed in the interval from the base of the Mugu aquifer down to at least 20 feet below the base (See Figure 5). Inert filler material may be placed opposite the water-bearing zones. Elevations on the base of the Mugu aquifer are shown on Figure 2.

APPENDIX A

LIST OF REFERENCES

APPENDIX A

LIST OF REFERENCES

The following reports, bulletins, and abstracts were reviewed during the course of this investigation. While this list is by no means exhaustive, the publications cited were used as the primary background materials in this study.

American Water Works Association. "AWWA Standard for Deep Wells". A.W.W.A. A-100-58. September 1958.

Associated Drilling Contractors of the State of California. "Recommended Standards for Preparation of Water Well Construction Specifications". September 1960.

Cal Engineers. "Ventura County Waste Disposal Study". May 1958.

California Department of Conservation, Division of Mines and Geology. "Geology of the Lockwood Valley Area, Kern and Ventura Counties, California". Special Report 81. 1964.

California Department of Natural Resources, Division of Mines. "Geologic Formations and Economic Development of the Oil and Gas Fields of California". Bulletin 118. 1943.

----. "Geology of Southern California". Bulletin 170. 1954.

California Department of Public Health. "Sanitation Guide for Small Water Systems." July 1953.

California Department of Public Works, Division of Water Resources. "Ventura County Investigation". Bulletin No. 46 - Report. Bulletin No. 46A - Basic Data. 1933.

----. "Water Quality Investigations, First Progress Report to Los Angeles Regional Water Pollution Control Board, Ventura County Oil Waste Investigation". May 1952.

----. "Water Quality Investigations, Report to Regional Water Pollution Control Board (No. 4) on Waste Discharge No. 2 by the Culligan Water Service, El Rio, Ventura California". June 1953.

----. "Water Quality Investigation, a Report to Los Angeles Regional Water Pollution Control Board (No. 4), Ventura County Oil Waste Investigation". June 1954.

California Department of Public Works, Division of Water Resources. "Water Quality Investigations, Appendixes to Ventura County Oil Waste Investigation". June 1954.

----. "Abstract of Laws and Recommendations Concerning Water Well Construction and Sealing in the United States." Water Quality Investigations Report No. 9. April 1955.

----. "Water Quality Investigations, Report to Los Angeles Regional Water Pollution Control Board, Investigation of Waste Discharges from Water Softening Units, Los Angeles Region." May 1955.

----. "Ground Water Quality Monitoring Program in California." Water Quality Investigation Report No. 14. June 1956.

California Department of Water Resources. "Sea-Water Intrusion in California." Bulletin No. 63. November 1958.

----. "Water Quality and Water Quality Problems, Ventura County." Bulletin No. 75. Volume I: Test and Plates; Volume II: Appendixes. February 1959.

----. "Water Well Standards: State of California." Bulletin No. 74. February 1968.

----. "Names and Areal Code Numbers of Hydrologic Areas in Southern District." Office Report. April 1964.

----. "Proposed Refuse Disposal Site, Lockwood Valley, Ventura County, Department of Public Works." Memorandum to Los Angeles Regional Water Quality Control Board (No. 4).* February 9, 1965.

----. "Happy Valley School Domestic Waste Discharge, Upper Ojai Valley." Memorandum to Los Angeles Regional Water Pollution Control Board (No. 4). March 31, 1965.

----. "Ventura County and Upper Santa Clara River Drainage Area, Land and Water Use Survey, 1961." Bulletin No. 122. April 1965.

----. "Tidewater Oil Company, Oil Field Waste Disposal, Tapo Canyon, Ventura County." Memorandum to Los Angeles Regional Water Pollution Control Board (No. 4). August 23, 1965.

----. "Sea-Water Intrusion: Oxnard Plain of Ventura County." Bulletin No. 63-1. October 1965.

----. "City of Ventura Sewage Discharge to Mouth of Santa Clara River." Memorandum to Los Angeles Regional Water Quality Control Board (No. 4). October 25, 1965.

*Previous designation, Los Angeles Regional Water Pollution Control Board.

----. "T. A. Smith Trucking, Oil Field Waste Discharge, Vicinity of Oxnard". Memorandum to Los Angeles Regional Water Quality Control Board (No. 4). February 21, 1966.

----. "Ground Water Basin Protection Projects: Oxnard Basin Salinity Barrier, Ventura, County". Progress Report. March 1967

----. "Ground Water Basin Protection Projects: Design and Construction of the Oxnard Plain Experimental Barrier Facility". August 1967.

----. "Ground Water Basin Protection Projects: Santa Clara River Valley Water Quality Study". (In preparation)

California Water Resources Board. "Ventura County Investigation". Bulletin No. 12. Volume I: Text; Volume II: Appendixes and Plates. October 1953. Revised April 1956.

California Regional Water Pollution Control Board (No. 4). "Second Progress Report on Possible Ground Water Pollution from the Citrus Packing Plants, Ventura County, California". March 1959.

Mann, John F., Jr., and Associates. "Overdraft on the Deep Aquifer in Pleasant Valley and Possibilities of Recharge by Spreading". July 1952.

----. "A Plan for Ground Water Management, United Water Conservation District". September 1959.

Meinzer, O. "Hydrology". Dover Publications. New York. 1942.

The Metropolitan Water District of Southern California. "Report for the Fiscal Year July 1, 1964, to June 30, 1965". 1965.

Poland, J. F., Garrett, A. A., and Mann, J. F. "Progress Report on Water Supply for the Point Mugu Naval Base, Ventura County, California". U. S. Geological Survey. August 20, 1948.

U. S. Department of Commerce, Bureau of the Census, "United States Census of 1950 Population, General Characteristics, California". 1952.

----. "United States Census of Population, 1960, General Population Characteristics". 1961.

Upson, J. E. "Geology and Ground Water Resources of the South Coast Basins of Santa Barbara County, California". U. S. Geological Survey Water Supply Paper 1108. 1951.

Upson, J. E. and Worts, G. F., Jr., "Ground Water of the Cuyama Valley, California". U. S. Geological Survey Water Supply Paper 1110-B. 1951.

U. S. Department of Health, Education, and Welfare. "Public Health Service Drinking Water Standards, 1962". 1962.

APPENDIX B

DEFINITION OF TERMS

APPENDIX B

DEFINITION OF TERMS

The following terms are defined as used in this report.

Annular Space - The space between two well casings or a well casing and the wall of the drilled hole.

Aquiclude - A formation or part of a formation which, although porous and capable of absorbing water slowly, will not transmit water fast enough to furnish an appreciable supply for wells or springs.

Aquifer - A formation or part of a formation which transmits water in sufficient quantity to supply pumping wells.

Casing - A tubular retaining structure, generally metal or concrete, which is installed in the excavated hole to maintain the well opening.

Confined Ground Water - A body of ground water overlain by material sufficiently impervious to sever free hydraulic connection with overlying ground water except at the intake. Confined ground water moves in conduits under pressure due to the difference in head between the intake and discharge areas of the confined water body.

Connate Water - Water entrapped in the voids of a sedimentary rock at the time it was deposited. This water may be fresh, brackish, or saline. Because of the dynamic geologic and hydrologic conditions in California, this definition has been altered in practice to apply to water in older formations, even though the water in these formations may have been altered in quality since the rock was originally deposited.

Contamination - Defined in Section 13005 of the California Water Code:

> " . . . an impairment of the quality of the waters of the State by sewage or industrial waste to a degree which creates an actual hazard to public health through poisoning or through the spread of disease . . . ."

Jurisdiction over matters regarding contamination rests with the California Department of Public Health and local health officers.

Degradation - Impairment in the quality of water due to causes other than disposal of sewage and industrial waste.

Destroyed Well - A water well which has been filled or plugged so that it will not produce water. A properly destroyed well is one which has been destroyed so that it will not produce water or act as a conduit for the movement of water.

Deterioration - An impairment of water quality.

Drilled Well - A well for which the hole is generally excavated by mechanical means such as the rotary or cable tool methods.

Dug Well - A well for which the hole is generally excavated by hand tools, and which is usually of shallower depth and larger diameter than drilled wells.

Electrical Conductivity - The reciprocal of the resistance in ohms between opposite faces of a centimeter cube of an aqueous solution at 25°C.

Forebay Area - An area that consists of unconfined ground water where hydraulic continuity with the ground surface generally exists and that is located so as to provide a supply of ground water by subsurface flow to a body of confined ground water.

Gravel-Packed Well - A well in which a gravel envelope is placed in the annular space to increase the effective diameter of the well and to prevent fine-grained sediments from entering the well.

Ground Water - That part of the water below the ground surface which underlies the water table.

Ground Water Basin - An area underlain by one or more permeable formations capable of furnishing a substantial water supply.

Ground Water Gradient - The slope of the ground water surface.

Hydrologic Data - Information pertaining to surface and ground waters.

Impairment - A change in quality of water which makes it less suitable for beneficial use.

Lens - Individual bed of clay, silt, sand, or gravel that thins out from the center to a feather edge all around.

Other Waste - Defined in Section 13005 of the California Water Code:

> ". . . any and all liquid or solid waste substance not sewage, from any producing, manufacturing or processing operation of whatever nature."

Overdraft - The average annual decrease in the amount of ground water in storage that occurs during a long time period under a particular set of physical conditions affecting the supply, use, and disposal (including extractions) of water in the ground water basin.

Parts Per Million (ppm) - One weight of solute per one million weights of solution at 20°C.

Perforations - A series of openings in a well casing, made either before or after installation of the casing, to permit the entrance of water into the casing.

Permeability - The capacity of a rock to transmit a fluid. The degree of permeability depends upon the size and shape of the pores, the size and shape of their interconnections, and the extent of interconnections.

Pollution - Defined in Section 13305 of the California Water Code;

> ". . . an impairment of the quality of the waters of the State by sewage or industrial waste to a degree which does not create an actual hazard to the public health but which does adversely and unreasonably affect such waters for domestic, industrial, agricultural, navigational, recreational or other beneficial use, or which does adversely and unreasonably affect the ocean waters and bays of the State devoted to public recreation."

Pressure Area - Area underlain by ground water under pressure.

Salt Balance - The relationship of salt input to salt output.

Sediment - Anything settling out of suspension or being transported by water.

Sewage - Defined in Section 13005 of the California Water Code:

> ". . . any and all waste substance, liquid or solid, associated with human habitation, or which contains or may be contaminated with human or animal excreta or excrement, offal, or any feculent matter."

Total Dissolved Solids (TDS) - The dry residue from the dissolved matter in an aliquot of a water sample remaining after evaporating the sample at a definite temperature.

Waste Water - The water that has been put to some use or uses and has been disposed of, commonly to a sewer or wasteway. It may be liquid industrial waste, or sewage, or both.

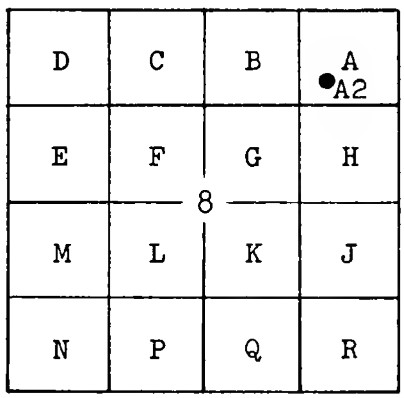
APPENDIX C

WELL NUMBERING SYSTEM

APPENDIX C

WELL NUMBERING SYSTEM

The well identification consists of a township, range, and section number, a letter which indicates the 40-acre lot in which the well is located, and a final number which indicates the identity of the particular well within the lot. The subdivision of a section is shown below:



For example, 2N/17W-8A2, SBB&M, is the second well to be identified in Lot A of Section 8 of Township 2 North, Range 17 West, San Bernardino Base and Meridian. Locations of wells are shown on Plates 2A, 2B, and 2C.

APPENDIX D

WATER QUALITY CRITERIA

APPENDIX D

WATER QUALITY CRITERIA

Criteria presented in the following sections can be utilized in evaluating mineral quality of water relative to existing or anticipated beneficial uses. These criteria are merely guides to the appraisal of water quality. Except for those constituents which are considered toxic to human beings, these criteria should be considered as suggested limiting values. Water which exceeds one or more of these limiting values need not be eliminated from consideration as a source of supply, but other sources of better quality water should be investigated.

Drinking Water Criteria

Criteria for appraising the suitability of water for domestic and municipal use in connection with interstate quarantine have been promulgated by the U. S. Public Health Service. The limiting concentrations of chemical substances in drinking water have been abstracted from these criteria and are shown in Table 9. Other organic or mineral substances may be limited if their presence renders the water hazardous for use.

Interim standards for certain mineral constituents have been adopted by the California Board of Public Health. Based on these standards, temporary permits may be issued for drinking water supplies failing to meet the U. S. Public Health Service Drinking Water Standards, provided the mineral constituents in Table 10 are not exceeded.

TABLE 9

U. S. PUBLIC HEALTH SERVICE
DRINKING WATER STANDARDS
1962

Dissolved constituent	Concentration which constitutes grounds for rejection*	Recommended maximum concentration*
Arsenic (As)	0.05	0.01
Barium (Ba)	1.0	
Cadmium (Cd)	0.01	
Chromium (hexavalent) (Cr^{+6})	0.05	
Cyanide (CN)	0.2	0.01
Lead (Pb)	0.05	
Selenium (Se)	0.01	
Silver (Ag)	0.05	
Chloride (Cl)		250.0
Copper (Cu)		1.0
Iron (Fe)		0.3
Manganese (Mn)		0.05
Nitrate (NO_3)		45.0
Sulfate (SO_4)		250.0
Zinc (Zn)		5.0
Phenols		0.001
Total dissolved solids, desirable		500.00
Alkyl benzene sulfonate (ABS)detergent		0.5
Carbon chloroform extract (CCE)		0.2

*Concentrations of the dissolved constituents in water are expressed in parts per million by weight.

TABLE 10

UPPER LIMITS OF TOTAL SOLIDS AND SELECTED MINERALS IN DRINKING WATER AS DELIVERED TO THE CONSUMER

In parts per million

Constituent	Permit	Temporary permit
Total solids	500 (1,000)*	1,500
Sulfates (SO_4)	250 (500)*	600
Chlorides (Cl)	250 (500)*	600
Magnesium (Mg)	125 (125)	150

*Numbers in parentheses are maximum permissible, to be used only where no other more suitable water is available in sufficient quantity for use in the system.

The California Board of Public Health has defined the maximum safe amounts of fluoride ion in drinking water in relation to mean annual temperature. These relationships are shown in Table 11.

TABLE 11

RELATIONSHIP OF TEMPERATURE TO FLUORIDE CONCENTRATION IN DRINKING WATER

Mean annual temperature	Mean monthly fluoride ion concentration, in parts per million
50° F	1.5
60° F	1.0
70° F - above	0.7

Criteria for Hardness

Even though hardness in water is not included in the foregoing standards, it is important to domestic and industrial uses. Excessive hardness in water used for domestic purposes causes increased consumption

of soap and formation of scale in pipe and fixtures. Table 12, which shows degrees of hardness in water, has been suggested by the U. S. Geological Survey.

TABLE 12

HARDNESS CLASSIFICATION

Range of hardness expressed as $CaCO_3$, in parts per million	Relative classification
100 or less	Soft
101 to 200	Moderately hard
Greater than 200	Very hard (usually requires softening)

Criteria for Irrigation Water

Criteria for mineral quality of irrigation water have been developed by the Regional Salinity Laboratories of the U. S. Department of Agriculture in cooperation with the University of California. Because of diverse climatological conditions and the variation in crops and soils in California, only general limits of quality for irrigation waters can be suggested. The Department uses three broad classifications for irrigation waters as listed below and in Table 13.

Class 1 - Regarded as safe and suitable for most plants under most conditions of soil and climate.

Class 2 - Regarded as possibly harmful for certain crops under certain conditions of soil or climate, particularly in the higher ranges of this class.

Class 3 - Regarded as probably harmful to most crops and unsatisfactory for all but the most tolerant.

These criteria have limitations in actual practice. In many instances, water may be wholly unsuitable for irrigation under certain

conditions of use, and yet be completely satisfactory under other circumstances. Consideration also should be given to soil permeability, drainage, temperature, humidity, rainfall, and other conditions that can alter the response of a crop to a particular quality of water.

TABLE 13

QUALITATIVE CLASSIFICATION OF IRRIGATION WATERS

Chemical properties	Class 1 Excellent to good	Class 2 Good to injurious	Class 3 Injurious to unsatisfactory
Total dissolved solids, in ppm	Less than 700	700 - 2,000	More than 2,000
Electrical conductivity, in micromhos at 25° C	Less than 1,000	1,000 - 3,000	More than 3,000
Chlorides, in ppm	Less than 175	175 - 350	More than 350
Sodium, in percent of base constituents	Less than 60	60 - 75	More than 75
Boron, in ppm	Less than 0.5	0.5 - 2.0	More than 2.0

Criteria for Industrial Uses

It is beyond the scope of this report to present water quality requirements for the numerous types of industry found in Ventura County or for the diverse processes within these industries, because such criteria are as varied as industry itself. In general, where a water supply meets drinking water standards, it is satisfactory for industrial use, either directly or following a limited amount of treatment or softening by the industry.

RNARY

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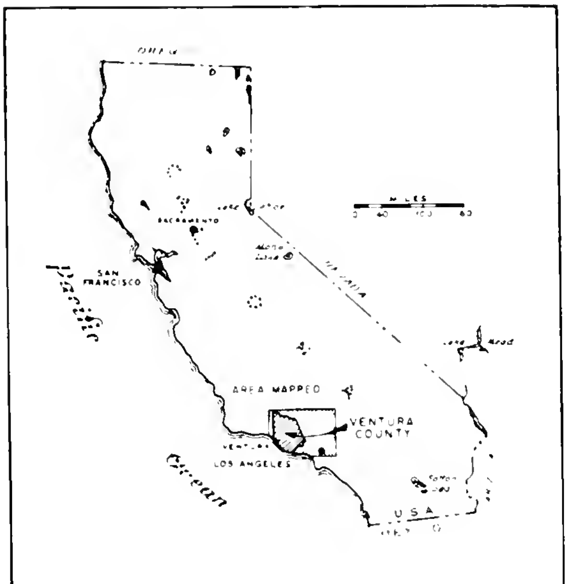

LOCATION MAP

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RY

RETACEOUS

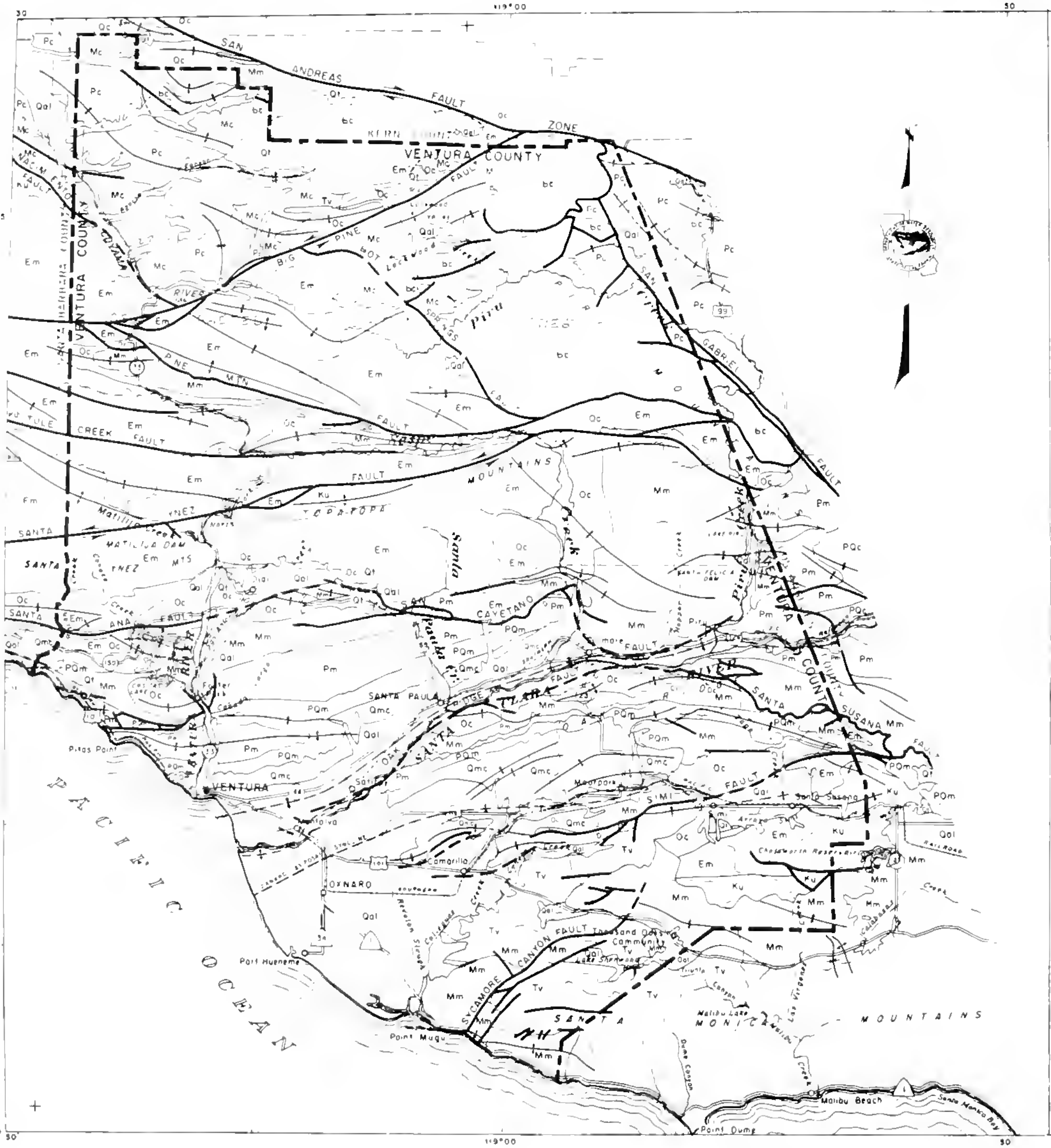
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER WELL STANDARDS
VENTURA COUNTY

AREAL GEOLOGY

MILES
0 1 2 4 6 8 10

1968



GEOLOGIC LEGEND

SEDIMENTARY FORMATIONS

RECENT	Qal	ALLUVIUM SAND, GRAVEL AND CLAY IN STREAM CHANNELS AND FLOOD PLAINS SUPPLIES MANY WELLS	QUATERNARY
PLEISTOCENE	Qt	TERRACE DEPOSITS AND OLDER ALLUVIUM GRAVEL SAND AND CLAY GENERALLY HIGHLY PERMEABLE SUPPLIES MANY WELLS	QUATERNARY
PLEISTOCENE	Qmc	SAN PEDRO FORMATION SAND GRAVEL AND CLAY MARINE AND CONTINENTAL PERMEABLE ZONES SUPPLY MANY WELLS INCLUDES FOX CANYON MEMBER WHICH YIELDS CONSIDERABLE WATER OF GOOD QUALITY IN THE LAS POSAS AND PLEASANT VALLEY AREAS	QUATERNARY
PLIOCENE	PQm	SANTA BARBARA FORMATION MARINE MUDSTONE SHALE SANDSTONE SAND, GRAVEL AND CLAY NONWATER-BEARING EXCEPT FOR GRIMES CANYON MEMBER WHICH SUPPLIES SOME WELLS IN THE LAS POSAS—PLEASANT VALLEY AREA	TERTIARY
PLIOCENE	PQc	SAUGUS FORMATION SAND, SLIGHTLY CEMENTED GRAVEL AND CLAY CONTAINS MODERATELY PERMEABLE STRATA, YIELDS WATER TO FEW WELLS	TERTIARY
PLIOCENE	Pm	PICO FORMATION MARINE SANDSTONE SHALE LENSES OF CONGLOMERATE GENERALLY NONWATER-BEARING OR CONTAINS SALTY WATER	TERTIARY
PLIOCENE	Pc	RIDGE BASIN GROUP AND MORALES FORMATION CONTINENTAL SHALE SANDSTONE CONGLOMERATE GRAVEL AND SAND CONTAINS UNDEVELOPED PERMEABLE ZONES	TERTIARY
MIOCENE	Mm	SANTA MARGARITA, MODELO RINCON AND VAQUEROS FORMATIONS MARINE SANDSTONE AND SHALE, SOME CONGLOMERATE AND CLAY GENERALLY NONWATER-BEARING OR CONTAINS BRACKISH WATER LOCALLY PROVIDES LIMITED QUANTITIES OF FRESH WATER TO WELLS	TERTIARY
MIOCENE	Mc	MINT CANYON AND QUATAL FORMATIONS NON-MARINE SANDSTONE CONGLOMERATE GYPSIFEROUS CLAY AND SOME MARL GENERALLY NONWATER-BEARING	TERTIARY
OLIGOCENE	Oc	SESPE SIMMLER AND VASQUEZ FORMATIONS NON-MARINE SANDSTONE CONGLOMERATE AND SHALE GENERALLY NONWATER-BEARING OR CONTAINS BRACKISH WATER SUPPLIES FEW WELLS LOCALLY	TERTIARY
EOCENE AND PALEOCENE	Em	UNDIFFERENTIATED EOCENE AND PALEOCENE FORMATIONS MARINE SANDSTONE SHALE AND CONGLOMERATE PERMEABLE ZONES YIELD LIMITED QUANTITIES OF VARIABLE QUALITY WATER	TERTIARY
	Ku	UNDIFFERENTIATED MARINE FORMATIONS SANDSTONE SHALE AND LITTLE CONGLOMERATE PERMEABLE ZONES IN SOME AREAS YIELD WATER OF VARIABLE QUALITY IN LIMITED AMOUNT	CRETACEOUS

IGNEOUS AND METAMORPHIC ROCKS

Tv	VOLCANIC FLOWS PYROCLASTICS, AND SHALLOW INTRUSIVES YIELDS VARIABLE QUANTITIES OF WATER TO WELLS IMPORTANT WATER SOURCE IN SANTA ROSA, TIERRA REJADA AND CONEJO AREAS	TERTIARY
bc	BASEMENT COMPLEX GRANITIC AND METAMORPHIC ROCKS NONWATER-BEARING EXCEPT FOR LIMITED QUANTITIES OF WATER DERIVED FROM FISSURES OR WEATHERED ZONES	PRE-CRETACEOUS

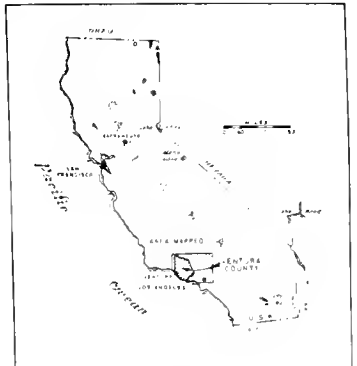
FAULT SURFACE TRACE

FAULT BURIED OR INFERRED

AXIS OF ANTICLINE
AXIS OF SYNCLINE } DASHED WHERE BURIED

FORMATION CONTACT

COMPILED IN 1953 FROM FIELD MAPPING BY THE STATE DIVISION OF WATER RESOURCES AND FROM PUBLISHED AND UNPUBLISHED MAPS AS ACKNOWLEDGED IN BULLETIN 12 "VENTURA COUNTY INVESTIGATION" OCTOBER 1953



LOCATION MAP

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

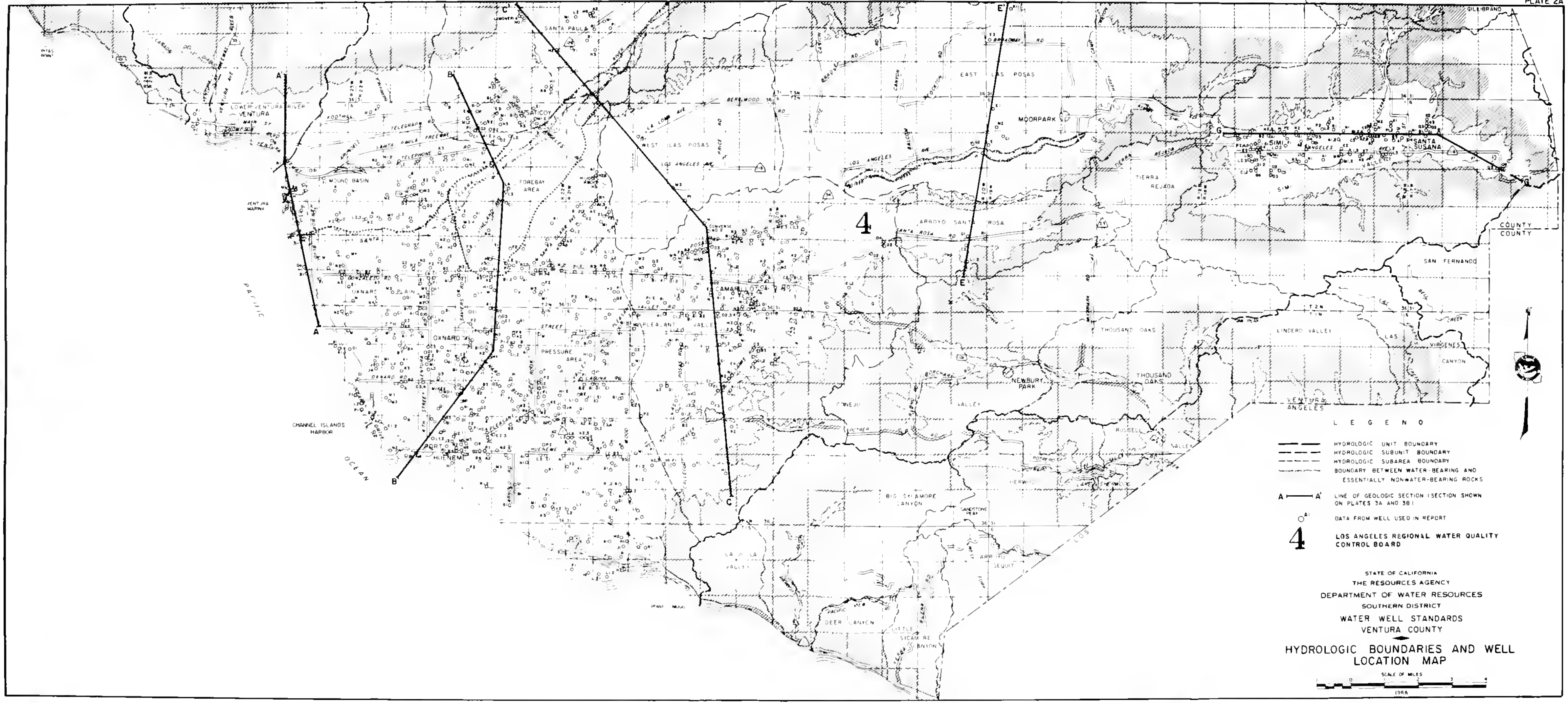
WATER WELL STANDARDS
VENTURA COUNTY

AREAL GEOLOGY

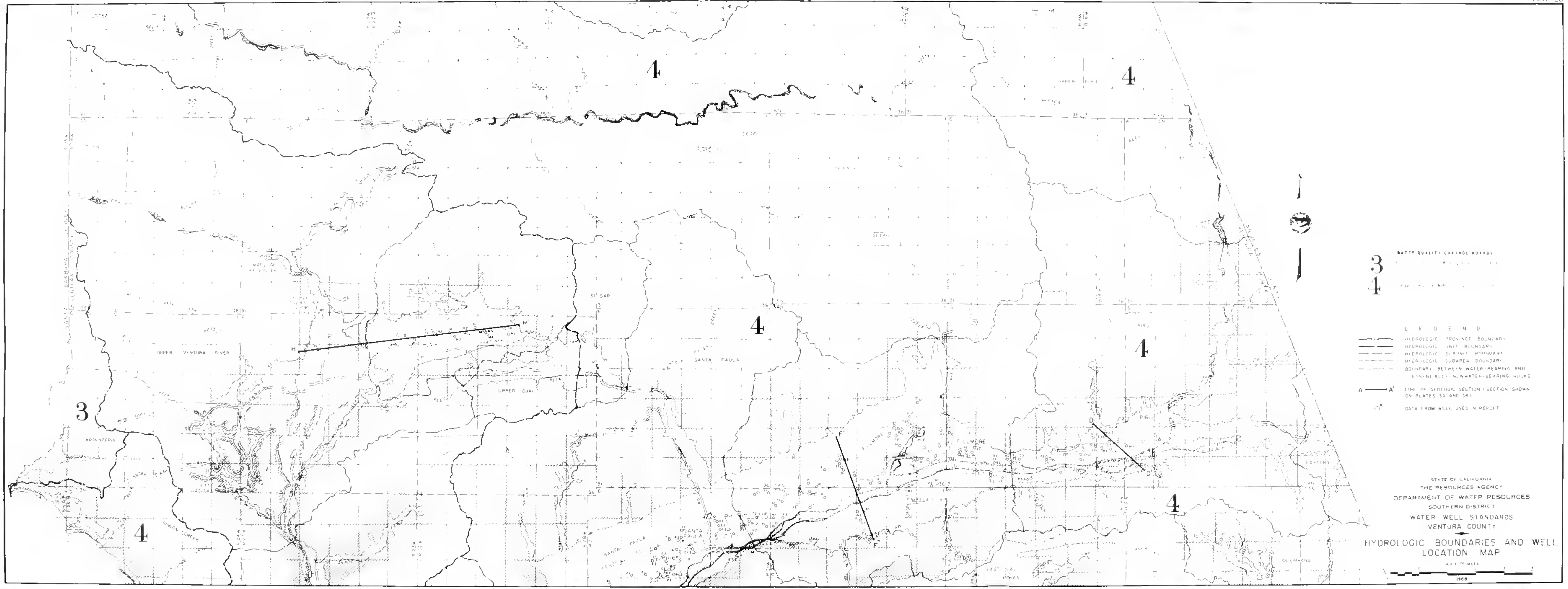
MILES
0 1 2 4 6 8 10

1968

PLATE 2A



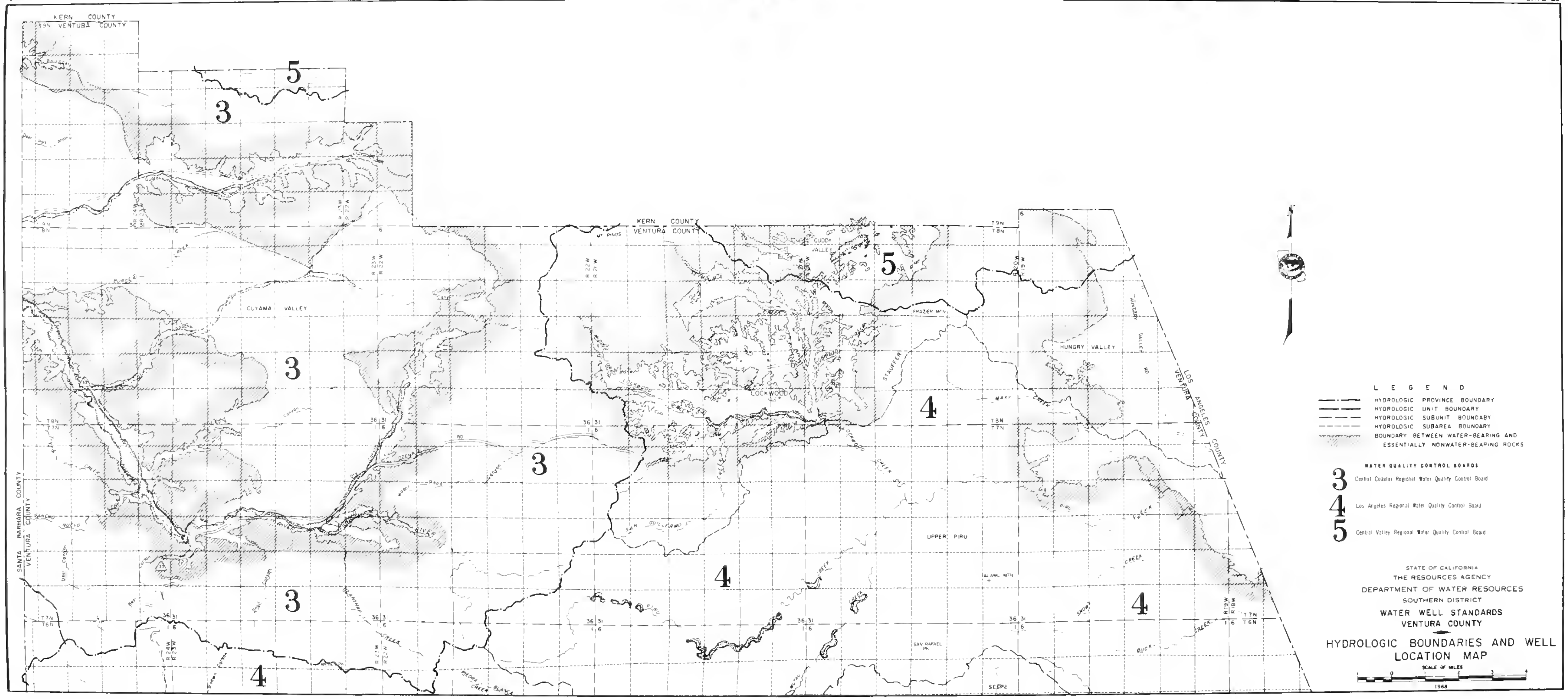
VENTURA
SATICOY
SANTA PAULA
FOREBAY AREA
MOUND BASIN
OXNARD PLAIN
OXNARD
PRESSURE AREA
PORT HUENEME
CHANNEL ISLANDS HARBOR
PACIFIC OCEAN
WEST LAS POSAS
EAST LAS POSAS
MOORPARK
CAMARILLO
PLEASANT VALLEY
ARROYO SANTA ROSA
SIMI
SANTA SUSANA
TIERRA REJADA
THOUSAND OAKS
NEWBURY PARK
CONEJO VALLEY
LINDERO VALLEY
LAS VIRGENES CANYON
SAN FERNANDO
RUSSELL VALLEY
BIG SYCAMORE CANYON
LA JOLLA VALLEY
DEER CANYON
LITTLE SYCAMORE CANYON
ARROYO SEQUIT
GILLIBRAND
VENTURA COUNTY
LOS ANGELES COUNTY
4
LEGEND
HYDROLOGIC UNIT BOUNDARY
HYDROLOGIC SUBUNIT BOUNDARY
HYDROLOGIC SUBAREA BOUNDARY
BOUNDARY BETWEEN WATER-BEARING AND ESSENTIALLY NONWATER-BEARING ROCKS
A — A' LINE OF GEOLOGIC SECTION (SECTION SHOWN ON PLATES 3A AND 3B)
DATA FROM WELL USED IN REPORT
4 LOS ANGELES REGIONAL WATER QUALITY CONTROL BOARD
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
WATER WELL STANDARDS
VENTURA COUNTY
HYDROLOGIC BOUNDARIES AND WELL LOCATION MAP
SCALE OF MILES
1968



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
WATER WELL STANDARDS
VENTURA COUNTY

HYDROLOGIC BOUNDARIES AND WELL LOCATION MAP

1968


KERN COUNTY
VENTURA COUNTY
CUYAMA VALLEY
MT. PINOS
CUDDY VALLEY
FRAZIER MTN
LOCKWOOD
HUNGRY VALLEY
UPPER PIRU
STAUFFER
SAN GUILLERMO
ALAMO MTN
SAN RAFAEL
SESPE
SANTA BARBARA COUNTY
VENTURA COUNTY
LOS ANGELES COUNTY
VENTURA COUNTY
T9N
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R 24 W
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R 22 W
R 21 W
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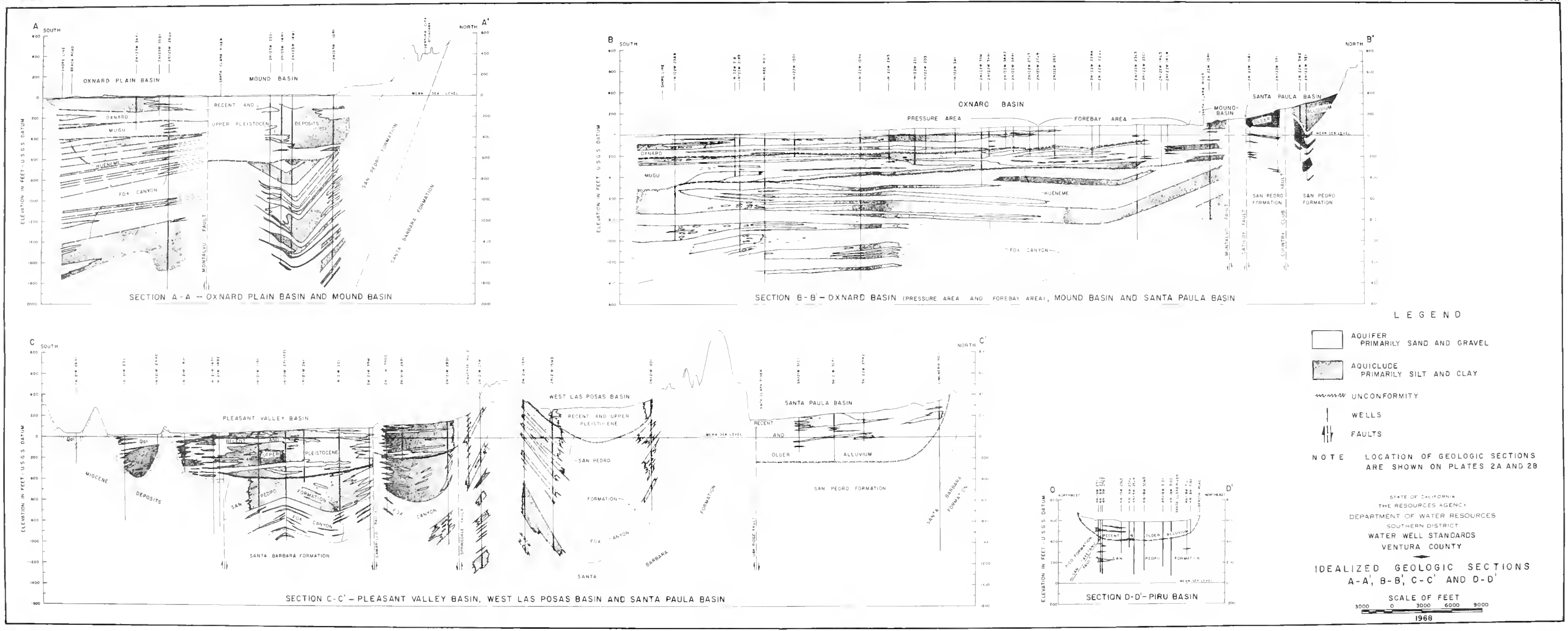
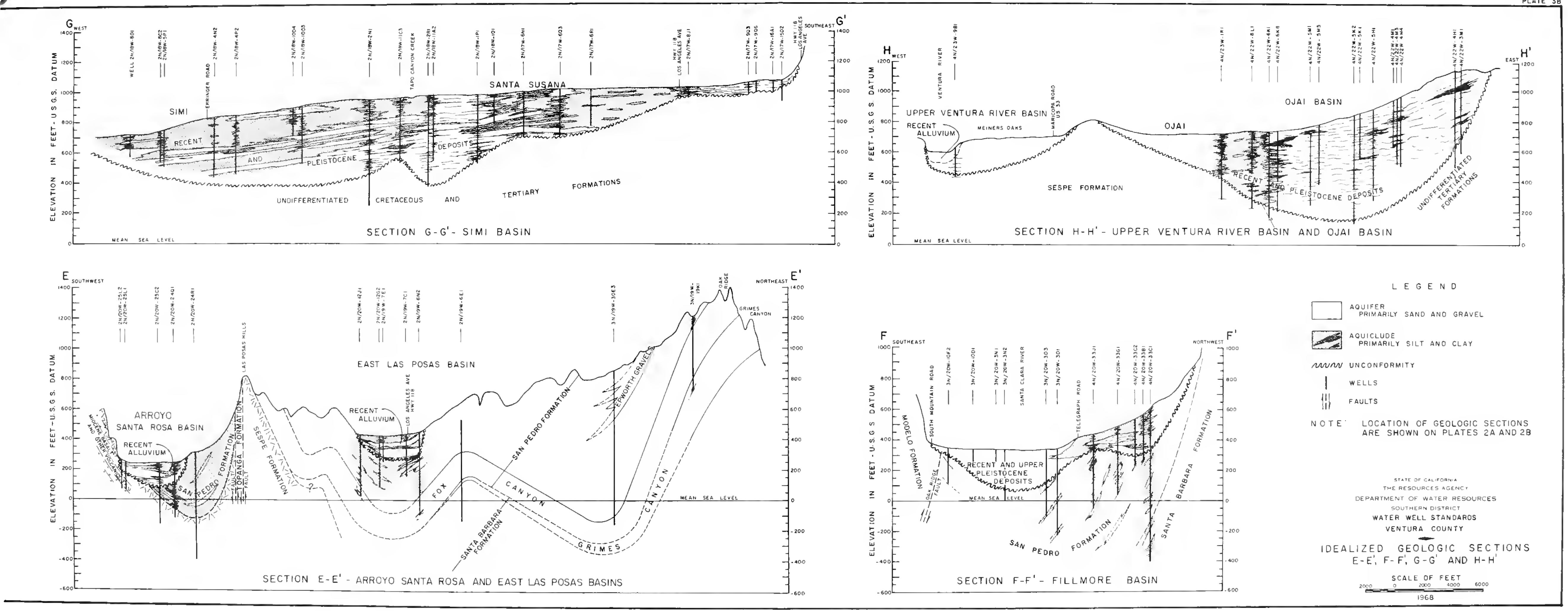
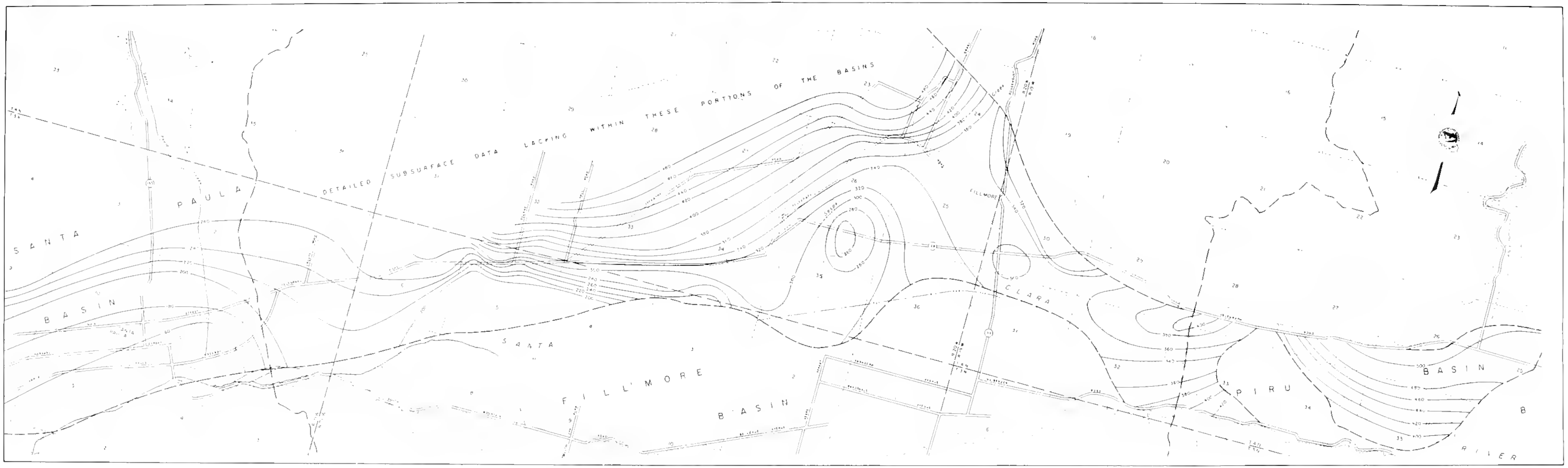
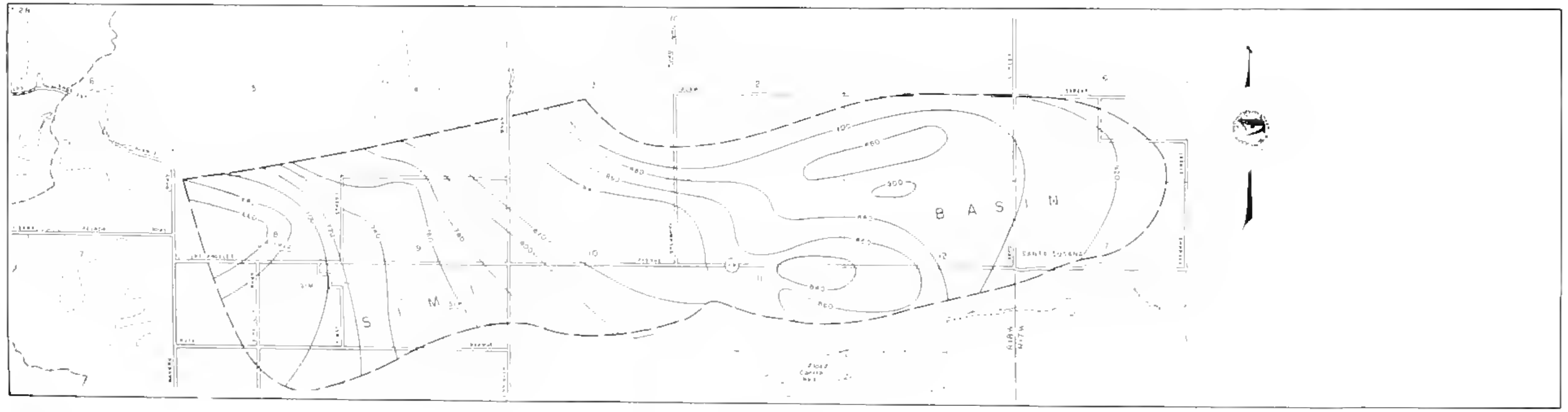
R 19 W
R 18 W
3
4
5
L E G E N D
HYDROLOGIC PROVINCE BOUNDARY
HYOROLOGIC UNIT BOUNDARY
HYOROLOGIC SUBUNIT BOUNDABY
HYOROLOGIC SUBAREA BOUNDARY
BOUNDARY BETWEEN WATER-BEARING AND ESSENTIALLY NONWATER-BEARING ROCKS
WATER QUALITY CONTROL BOARDS
3 Central Coastal Regional Water Quality Control Board
4 Los Angeles Regional Water Quality Control Board
5 Central Valley Regional Water Quality Control Board
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
WATER WELL STANDARDS
VENTURA COUNTY
HYDROLOGIC BOUNDARIES AND WELL LOCATION MAP
SCALE OF MILES
1 0 1 2 3 4
1968


SECTION A-A' – OXNARD PLAIN BASIN AND MOUND BASIN
OXNARD PLAIN BASIN
MOUND BASIN
RECENT AND UPPER PLEISTOCENE DEPOSITS
OXNARD
MUGU
HUENEME
FOX CANYON
MONTALVO FAULT
SAN PEDRO FORMATION
SANTA BARBARA FORMATION
MEAN SEA LEVEL
ELEVATION IN FEET - USGS DATUM
SOUTH
NORTH
SECTION B-B' – OXNARD BASIN (PRESSURE AREA AND FOREBAY AREA), MOUND BASIN AND SANTA PAULA BASIN
OXNARD BASIN
PRESSURE AREA
FOREBAY AREA
MOUND BASIN
SANTA PAULA BASIN
ALLUVIUM
SAN PEDRO FORMATION
MONTALVO FAULT
SATICOY FAULT
COUNTRY CLUB FAULT
FOX CANYON
SECTION C-C' – PLEASANT VALLEY BASIN, WEST LAS POSAS BASIN AND SANTA PAULA BASIN
PLEASANT VALLEY BASIN
WEST LAS POSAS BASIN
SANTA PAULA BASIN
RECENT AND UPPER PLEISTOCENE
RECENT AND OLDER ALLUVIUM
MIOCENE DEPOSITS
SAN PEDRO FORMATION
FOX CANYON
SANTA BARBARA FORMATION
CAMARILLO FAULT
SPRINGVILLE FAULT
OAK RIDGE FAULT
SECTION D-D' – PIRU BASIN
RECENT
OLDER ALLUVIUM
SAN PEDRO FORMATION
PICO FORMATION
SAN CAYETANO FAULT
LEGEND
AQUIFER PRIMARILY SAND AND GRAVEL
AQUICLUDE PRIMARILY SILT AND CLAY
UNCONFORMITY
WELLS
FAULTS
NOTE LOCATION OF GEOLOGIC SECTIONS ARE SHOWN ON PLATES 2A AND 2B
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
WATER WELL STANDARDS
VENTURA COUNTY
IDEALIZED GEOLOGIC SECTIONS A-A', B-B', C-C' AND D-D'
SCALE OF FEET
3000 0 3000 6000 9000
1968


SECTION G-G' - SIMI BASIN
SECTION H-H' - UPPER VENTURA RIVER BASIN AND OJAI BASIN
SECTION E-E' - ARROYO SANTA ROSA AND EAST LAS POSAS BASINS
SECTION F-F' - FILLMORE BASIN
ELEVATION IN FEET - U.S.G.S. DATUM
MEAN SEA LEVEL
SIMI
SANTA SUSANA
RECENT AND PLEISTOCENE DEPOSITS
UNDIFFERENTIATED CRETACEOUS AND TERTIARY FORMATIONS
UPPER VENTURA RIVER BASIN
RECENT ALLUVIUM
MEINERS OAKS
OJAI
OJAI BASIN
SESPE FORMATION
UNDIFFERENTIATED TERTIARY FORMATIONS
ARROYO SANTA ROSA BASIN
EAST LAS POSAS BASIN
SAN PEDRO FORMATION
SANTA BARBARA FORMATION
FOX CANYON
GRIMES CANYON
EPWORTH GRAVELS
OAK RIDGE
MODELO FORMATION
RECENT AND UPPER PLEISTOCENE DEPOSITS
SANTA BARBARA FORMATION
LEGEND
AQUIFER PRIMARILY SAND AND GRAVEL
AQUICLUDE PRIMARILY SILT AND CLAY
UNCONFORMITY
WELLS
FAULTS
NOTE: LOCATION OF GEOLOGIC SECTIONS ARE SHOWN ON PLATES 2A AND 2B
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
WATER WELL STANDARDS
VENTURA COUNTY
IDEALIZED GEOLOGIC SECTIONS E-E', F-F', G-G' AND H-H'
SCALE OF FEET
2000 0 2000 4000 6000
1968





L E G E N D

— - -	BOUNDARY BETWEEN WATER BEARING AND ESSENTIALLY NONWATER BEARING ROCKS
—800—	LINE OF EQUAL ELEVATION ON BASE OF SEALING ZONE II
— — -	BOUNDARY OF SEALING ZONE II
— — —	HYDROLOGIC SUBUNIT BOUNDARY
- - - - - -	HYDROLOGIC SUBAREA BOUNDARY

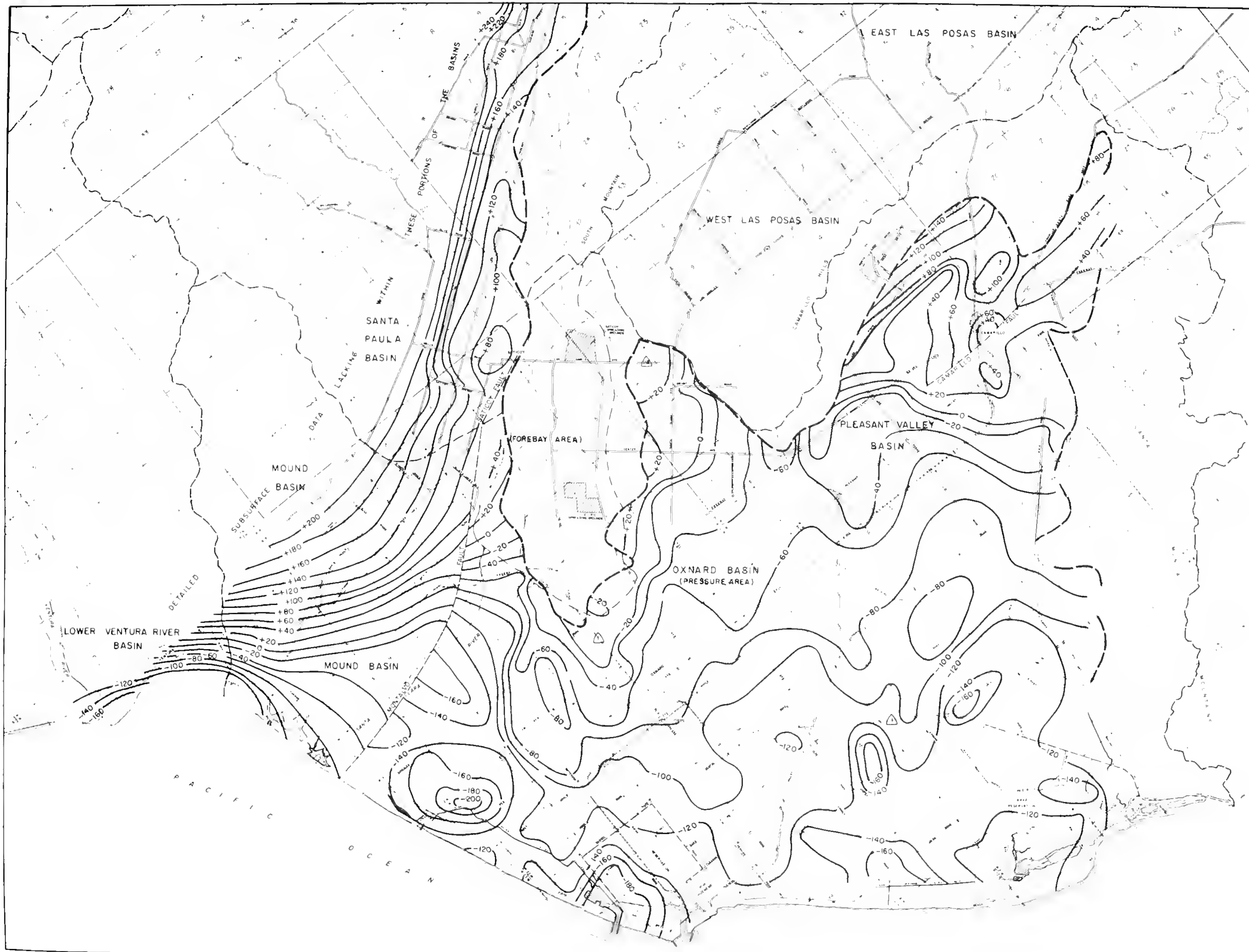
NOTE
CONTOURS ARE REFERENCED TO MEAN SEA LEVEL US GEOLOGICAL SURVEY DATUM

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
WATER WELL STANDARDS
VENTURA COUNTY

LINES OF EQUAL ELEVATIONS ON BASE OF SEALING ZONE II

SCALE OF FEET
2000 0 2000 4000

1968



LEGEND

BOUNDARY BETWEEN WATER BEARING AND ESSENTIALLY NONWATER BEARING ROCKS
HYDROLOGIC UNIT BOUNDARY
HYDROLOGIC SUBUNIT BOUNDARY
HYDROLOGIC SUBAREA BOUNDARY
GROUND WATER BASIN BOUNDARY
FOREBAY AREA BOUNDARY
FAULT
-40- LINE OF EQUAL ELEVATION ON BASE OF SEALING ZONE
BOUNDARY OF SEALING ZONE II

NOTE CONTOURS ARE REFERENCED TO MEAN SEA LEVEL U.S.G.S. DATUM

STATE OF CALIFORNIA
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SOUTHERN DISTRICT
WATER WELL STANDARDS
VENTURA COUNTY

LINES OF EQUAL ELEVATIONS ON BASE OF SEALING ZONE II

SCALE OF FEET
4000 0 4000 8000 12000

1968